WESTINGHOUSE CLASS 3

WCAP-10574

DECONTAMINATION AND DECOMMISSIONING OF THE WESTINGHOUSE NUCLEAR FUEL FACILITY AT CHESWICK, PA

FOR

UNITED STATES DEPARTMENT OF ENERGY

CONTRACT NO. DE-AC06-82RL10363

Volume 1 of 2 PA. 10-3

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June 1984

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Work Performed Under Shop Order Number PFDL-50503

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7471B:1b/061384

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ABSTRACT

This report documents the efforts associated with the decontamination and decommissioning of the Westinghouse Nuclear Fuel Facility at Cheswick, Pennsylvania. The facility and its operations, along with non-destructive assay techniques, the management of transuranic waste, and the equipment required for dismantling and packaging these waste, are described. The report also presents detailed plans and procedures that were developed and implemented for this effort. The construction and use of a sectioning facility for large contaminated items is also discussed, and the results of the radiological survey are summarized. Finally, recommendations are given for the decontamination and decommissioning of existing facilities and for the design and construction of new facilities.

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SECTION 1
SITE/FACILITY DESCRIPTION

1.1 INTRODUCTION

In the period 1980 through 1983, the Westinghouse Electric Corporation's Nuclear Fuel Division decontaminated and decommissioned a pilot plant facility that had been used for development and fabrication of mixed plutonium-uranium (mixed oxide) fuels. This facility, the Plutonium Fuels Development Laboratory (PFDL), had been in operation for 10 years, producing light water and fast breeder reactor fuels on a development and pilot-plant scale. Operations within the facility were conducted by two Westinghouse divisions, the Nuclear Fuel Division (NFD) and the Advanced Reactors Division (ARD). The NFD was responsible for the operation of the facility. This report describes the decontamination and decommissioning effort for the NFD portion of the operations, and for the structure and grounds. The ARD's decontamination and decommissioning experiences have been reported in detail(1) and will be discussed only where the information is relevant to the NFD operations.

1.2 FACILITY AND OPERATIONS

1.2.1 <u>Background</u>

The PFDL was constructed by the Westinghouse Electric Corporation in the late 1960s at Cheswick, Pennsylvania. The primary purpose of this facility was to fabricate demonstration uranium-plutonium fuel, and develop equipment and techniques for the fabrication of advanced plutonium-bearing fuels and fuel rod assemblies. The two Westinghouse divisions participating in this activity (NFD and ARD), placed emphasis on light water reactor (LWR) and fast breeder reactor applications, respectively. An application for a license to possess and use Special Nuclear Material (SNM) was submitted November 12, 1968, and License SNM-1120 was issued March 7, 1969.

Between 1969 and 1979, demonstration fuel rods were manufactured for five commercial light water reactors. These efforts involved the fabrication of approximately 4,600 fuel rods containing more than 6 tonnes of mixed oxide fuel pellets. Fabrication of these rods required handling of nearly 200 kilograms of plutonium of various isotopic analyses. The plutonium content of the fabricated rods ranged from less than 2 percent to 6 percent, with a nominal plutonium level of approximately 3 percent. The diluent consisted of natural and depleted uranium oxide (UO_2). The basic process used was to mix natural or depleted uranium oxide with plutonium oxide (PuO_2), press and sinter pellets, and load pellets into rods which were then sealed by welding. Isotopic compositions of the plutonium utilized in these programs are listed in Table 1-1.

During the time the facility was in operation, it was also engaged in an extensive effort involving development of equipment for the fabrication process of a full-scale recycle fuels plant. Automatic pressing and grinding equipment was evaluated and modified for remote operation, and various methods for grinder sludge recovery were investigated. A pilot model sintering furnace was installed and evaluated. Methods and parameters were established for recycle of green scrap, sintered scrap, and scrap contaminated with extraneous matter.

Other activities included analytical and radiochemistry process development, and applications of modern safeguards and security systems. Scrap recovery operations were performed in the chemical processing laboratory; scrap was dissolved in nitric acid and the plutonium was recovered by ion exchange and then converted to oxalate and, subsequently, oxide powder.

In 1979 a decision was made by the NFD to close the PFDL. This decision was based on political and economic reasons. Since that time, the activities in the PFDL have been to decontaminate the facility so that it can be released for unrestricted use. This report describes the results of the decontamination and decommissioning effort.

TABLE 1-1

ISOTOPIC COMPOSITION OF PFDL-FABRICATED FUEL RODS

	Isotope Concentration (%)				
Program	Pu-238	Pu-239	Pu-240	Pu-241	Pu-242
A	0.29	80.48	13.36	5.09	0.77
B	0.09	78.08	18.32	3.05	0.47
C	0.30	77.62	15.67	4.46	0.95
D	0.84	71.48	18.37	7.44	1.88
E	0.2/0.6	70/75	18/20	5/8	1/2

1.2.2 Laboratory Facilities

At the onset of the decontamination and decommissioning activities, the general arrangement of the ground floor of the PFDL Building 8 laboratory was as shown in Figure 1-1, which indicates the location of process and support areas and glove boxes. This building had remained essentially unchanged from the time it was constructed and committed to plutonium fabrication operations. The facility consisted of approximately 16,000 square feet on the ground floor for the production, development, and support activities used for the fabrication of uranium-plutonium fuels. The second story, or penthouse, provided 6,400 square feet of floor space for facility support systems such as duct and final High Energy Particulate Arrestant (HEPA) filters, ventilation fans, a cooling water recirculating system, and process acid make-up tanks. Figure 1-2 shows the building; the black structure on the left is the glass wall office structure. The NFD operations had occupied all the facility with the exception of the area in Figure 1-1 identified as "Area J - NDA and Storage (Former ARD Lab)."

The main laboratory area was 60 x 240 feet, and the receiving and shipping annex (Area I of Figure 1-1) was 40 x 60 feet. The second story (penthouse) covered an area of 40 x 160 feet and was located over the main laboratory area. The basic structure of the main laboratory was steel-beam construction. Exterior walls were covered with vinyl-coated corrugated steel bolted to the steel structure. The ground-level floor was reinforced concrete. The inside height of the first story was 15-1/2 feet to the bottom of the roof/second story floor. A false ceiling constructed of plastered gypsum lathe was suspended 14 feet above the floor. The space above the suspended ceiling was not utilized and contained only structural members supporting the second story floor.

The interior side of the exterior walls on the first story was finished with steel studs faced with gypsum lathe and plaster. All interior partitions in the first story were nonload bearing and were constructed of steel studs faced with gypsum lathe and plaster. The first story of the main laboratory, therefore, consisted basically of a box with a concrete floor and plastered walls and ceiling.

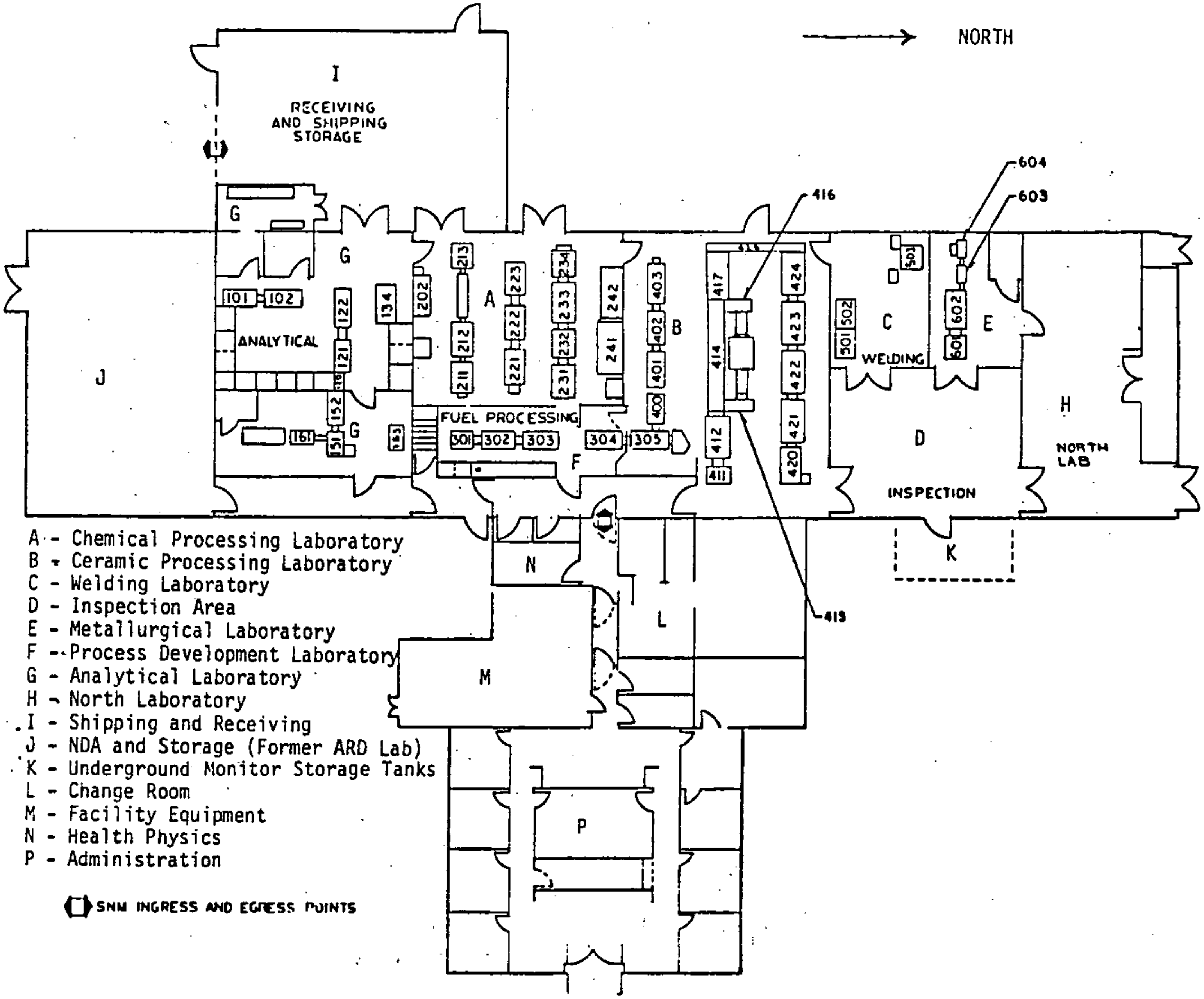

Figure 1-1. Plutonium Fuels Development Laboratory, Building 8, Ground Floor

Figure 1-2. Plutonium Fuels Development Laboratory Building 8

The receiving and shipping annex was constructed of a steel frame with corrugated steel walls and ceiling and a reinforced concrete floor.

The floor of the second story, over the main laboratory, was reinforced concrete. The interior of the second story was not partitioned, and the walls and ceiling were unfinished. Roofs were of standard construction consisting of rigid insulation with a built-up, gravel-covered surface.

The first-story floor of the main laboratory had a 6-inch-high concrete sill around the entire periphery to contain any liquid releases within the facility; there were no floor drains on the ground-level floor. Piping to handle potentially contaminated process water was installed under this floor. This piping directed waste water from various sinks, air-conditioner condensate drains, and cooling systems on the first and second floors to three holding tanks located below ground, just outside the structure at the area identified as "K" in Figure 1-1.

The laboratory as originally constructed contained a pit approximately 6 feet in diameter by 18-feet deep located in the floor of the welding laboratory. This pit was intended for fuel rod compaction studies, but was never used. Several years after the laboratory commenced operations, the pit was filled with gravel and cemented flush with the floor. During decommissioning it was discovered that adequate contamination survey records were not available for this pit; therefore, the gravel was removed and the pit was surveyed and back-filled again.

1.2.3 Other Facilities

In addition to the primary laboratory, offices and other support facilities were located contiguous and adjacent to the structure. A one-story structure was attached to the east side of the laboratory. This structure contained an equipment room for electrical and compressed air supplies, a health physics office, locker rooms, and general offices. A separate building (Building 10) located to the east of the offices was utilized for supplies and maintenance activities; the only radioactive materials handled in this building were those packaged for transportation.

1.3 LABORATORY OPERATIONS

1.3.1 Introduction

During the time the laboratory was in use, the operational philosophy was to maintain a clean structure; all operations involving exposed radioactive material were performed within glove boxes, hoods, or, in a few cases, completely enclosed temporary structures within the confines of the laboratory. Floors were routinely surveyed, and all areas with alpha smear levels in excess of 10 dpm/100 cm^2 were immediately cleaned. A few relatively minor releases occurred; in such instances, all the involved equipment and structure was immediately decontaminated. As a general practice, contamination was not "painted over."

1.3.2 Operations Performed

In the NFD operations, plutonium oxide (PuO_2) powder and natural uranium oxide (UO_2) powder were weighed and mechanically blended to produce a homogeneous powder. The plutonium fissile content of the mixed oxide material ranged from 1.5 to 3.5 percent for most light water reactor applications. After blending, the mixed oxide powder was prepressed (slugged) into large tablets which were granulated to form a coarse powder suitable for further processing. The granulated powder was mixed with a die lubricant and then pressed into green (unsintered) fuel pellets approximately 0.4 inch in diameter and 0.7 inch long. These pellets were sintered at a high temperature in a reducing atmosphere, and after cooling, were ground to a specified diameter. The ground pellets were inspected for proper dimensions, density, and chemical properties. Fuel rods were then loaded by inserting the required quantity of inspected and accepted pellets into a Zircaloy tube welded at one end. The fuel rods were sealed by welding a plug onto the open end. Inspection of fuel rods for integrity (by X-ray and leak checking) and dimensional compliance completed the fabrication process.

Scrap pellets, powder, and other process waste was processed through a scrap recovery operation to reclaim the contained plutonium. The material was dissolved in heated nitric acid to produce a solution containing plutonium and uranium and other impurities. This solution was fed through ion-exchange columns to recover the plutonium as $Pu(NO_3)_4$. Plutonium oxalate was then precipitated from the nitrate solution and converted to PuO_2 for recycling into the fuel pellet manufacturing process.

1.3.3 Laboratory Facilities

Much of the laboratory contained glove boxes, located as shown on Figure 1-1, which were used to process various plutonium-containing materials. Glove boxes had also been located in the ARD laboratory (Area J, Figure 1-1). Figures 1-3 through 1-7 show typical glove boxes.

In Areas B and F, Fuel Processing (Figure 1-1), the mixed oxide Pu-U powder was fabricated into fuel pellets. Glove Boxes 302 through 305 were used for plutonium powder comminution, sieving, weighing, and storage. These boxes, as a consequence, were highly contaminated with undiluted plutonium powder. Glove Boxes 400 through 404 and 411 and 412 were used for blending and pressing of mixed oxide pellets. A 1-cubic-foot V-cone blender was located in Glove Box 400. Hydraulic presses were contained in Glove Boxes 401 and 411; hydraulic pump units were located underneath the glove boxes. The pellet sintering furnace was located between Glove Boxes 412 and 417; it was of standard construction with water-cooled high-temperature alloy preheating and cooling sections and a brick high heat zone with a ceramic muffle. Sintering boats were moved through the furnace by a hydraulic ram which pushed the train of boats. A continuous conveyor for returning boats to the entrance of the furnace was located in Glove Box 414; the conveyor was approximately 24 feet long and utilized an endless metal mesh belt. Glove Box 417 was used for pellet unloading from furnace boats. An endless conveyor was contained in an overhead glove box, No. 425, to move pellet containers from Glove Box 417 to Glove Box 424. This conveyor box was approximately 19 feet long. Glove Boxes 421 through 424 were for pellet grinding, drying, and inspection operations. A centerless grinder and centrifuge were located in Glove Box 423. Glove Box 420 was used for loading pellets into fuel rods. Glove Box 301 was used for development activities and waste compaction.

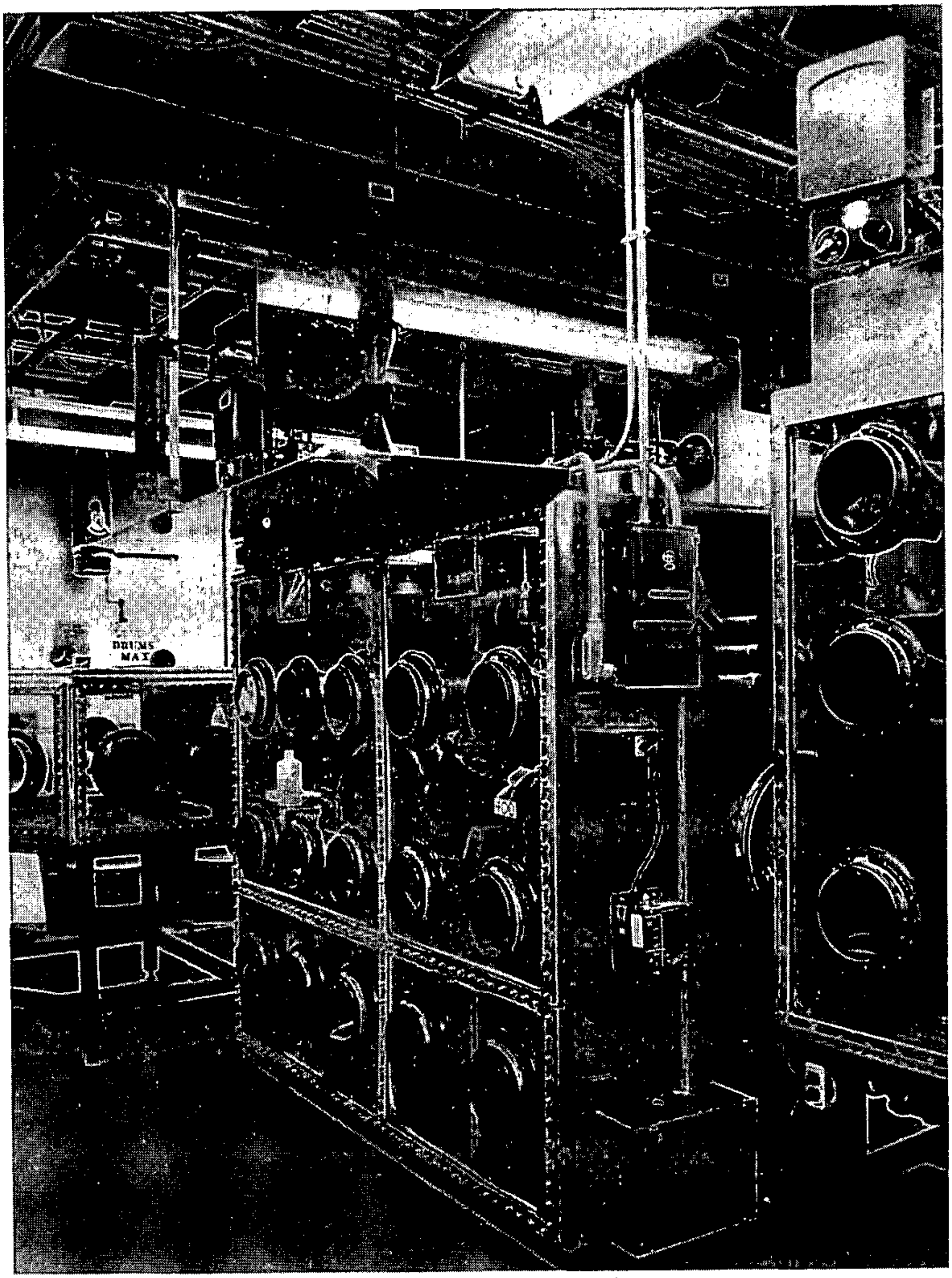

Figure 1-3. Glove Box Containing a V-Cone Blender for Blending Mixed Oxide Powder

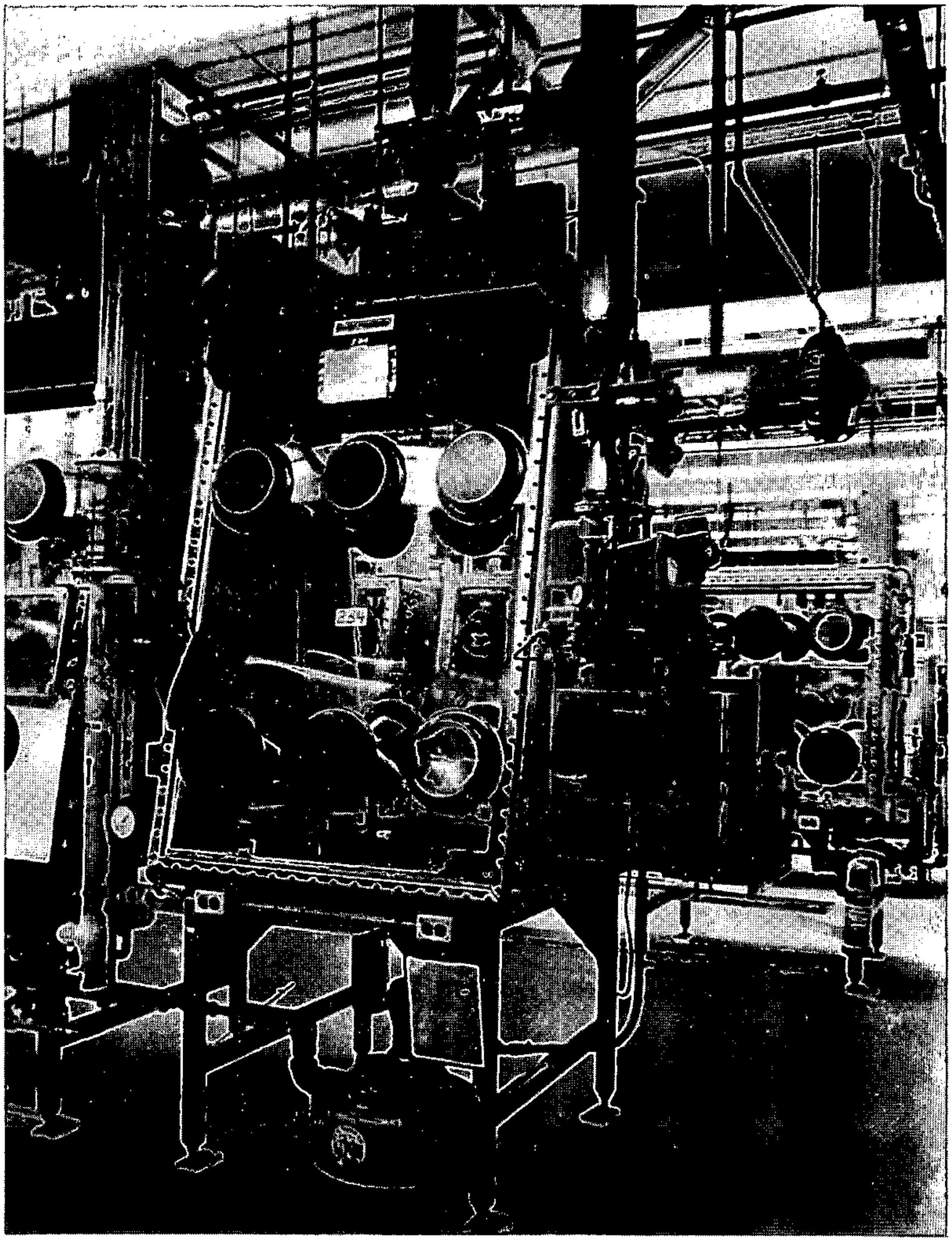

Figure 1-4. Glove Box With Typical Air Lock

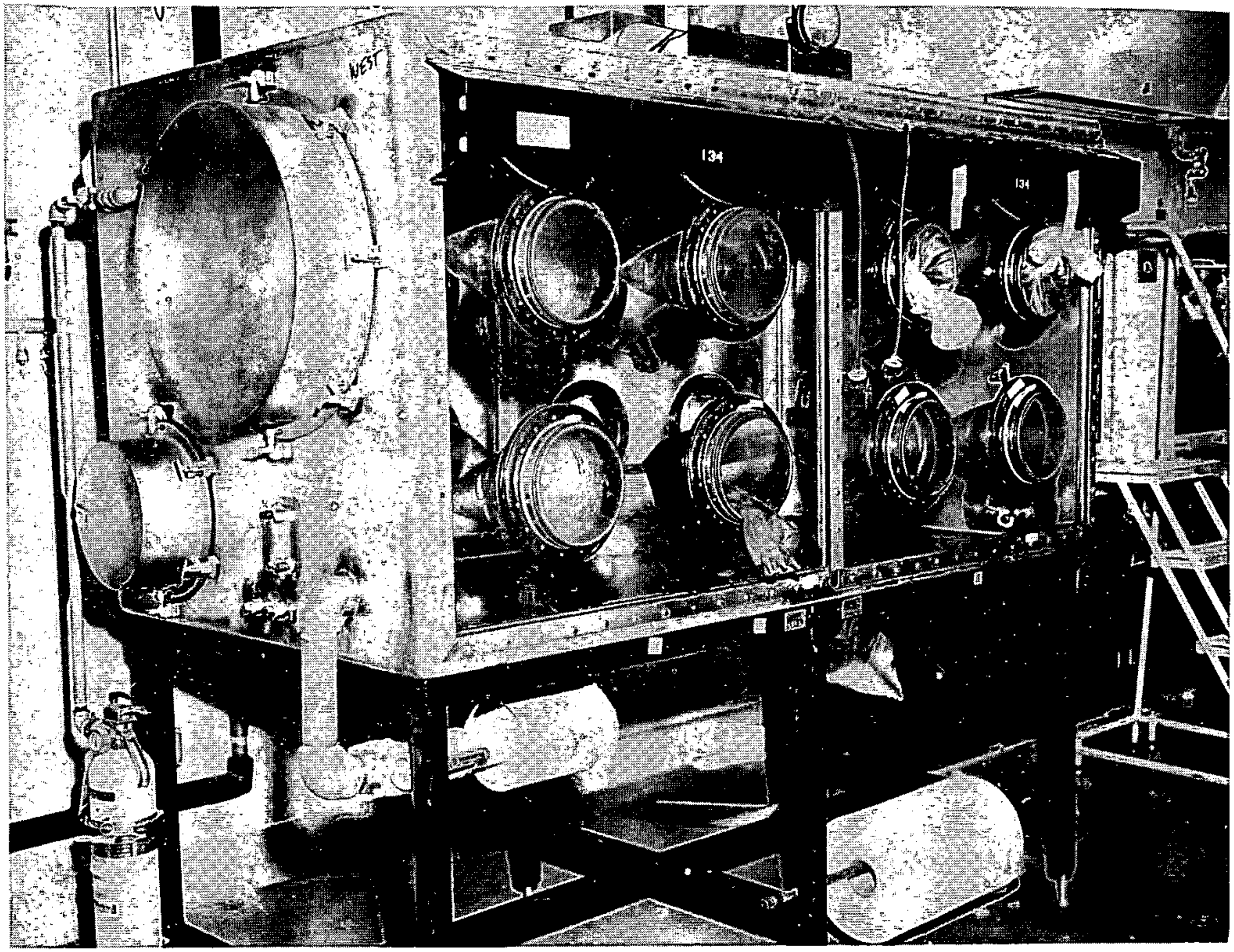

Figure 1-5. Typical Analytical Laboratory Glove Box
After Decontamination of Interior Surfaces

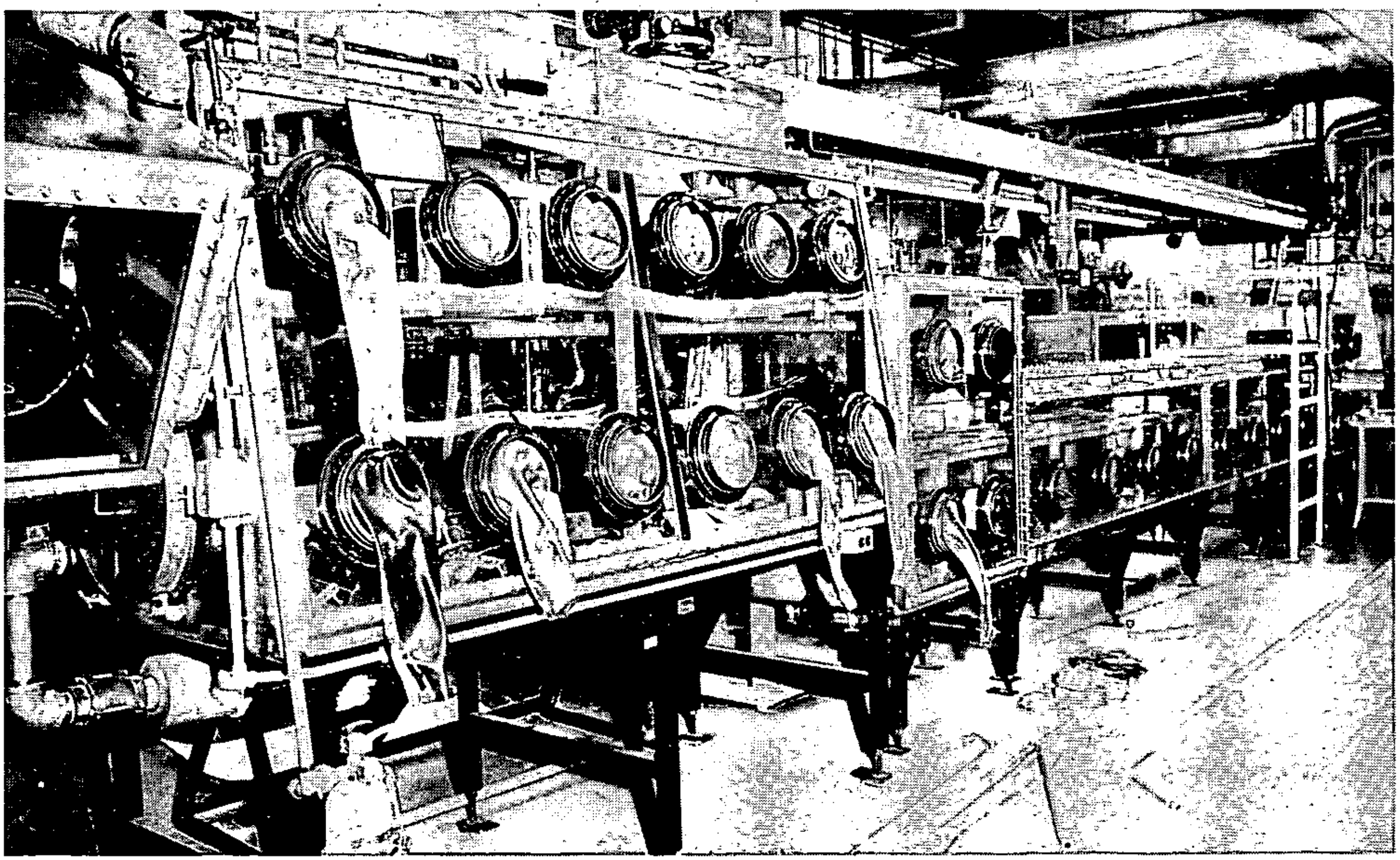

Figure 1-6. Glove Boxes Containing the Sintering Boat Return Conveyor System

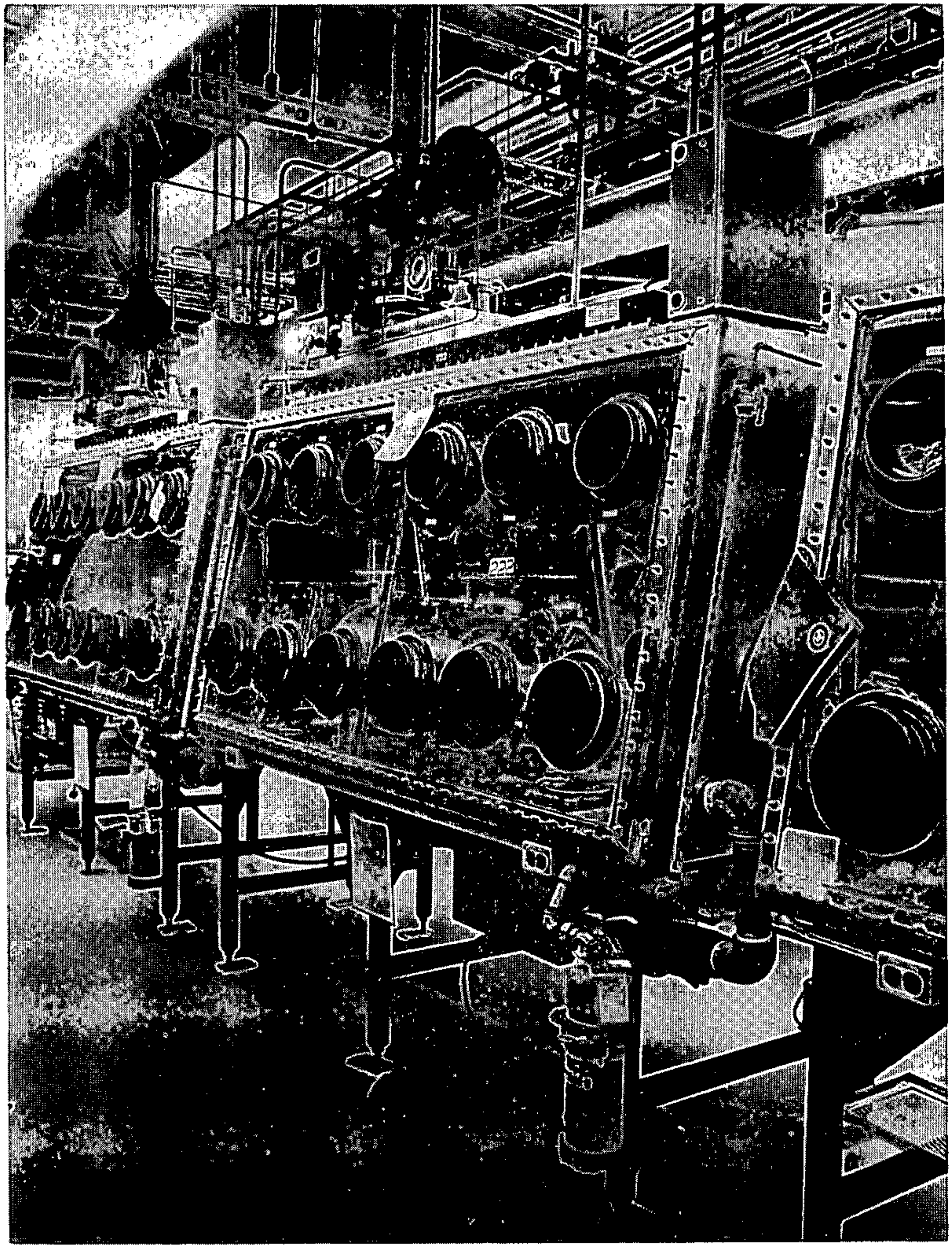

Figure 1-7. Typical Chemical Processing Glove Boxes

Area C, Welding (Figure 1-1), contained three small glove boxes in which fuel rods were capped and welded. Minimal contamination was encountered in these glove boxes. In Area E (Figure 1-1), there were four small glove boxes which contained metallographic equipment for fuel pellet evaluation.

The Chemical Processing Laboratory, Area A (Figure 1-1), contained the scrap reprocessing and plutonium recovery operations. This area had an extensive system of overhead liquid transfer pipes connecting many of the glove boxes.

The liquid transfer was accomplished with a vacuum system; traps and filters for this system were located in Glove Box 232. Glove Box 202 contained transfer lines and small (10 to 20 liter) storage tanks for unloading shipping containers of plutonium nitrate in solution. Glove Boxes 211 and 212 were used initially for coprecipitation development; during the decommissioning of the laboratory they were used for solidification of liquid waste in concrete. A small continuous-belt furnace for plutonium powder oxidation and reduction was connected between Glove Boxes 212 and 213; Glove Box 213 was used for powder handling. Glove Box 221 contained glass columns for precipitation of plutonium oxalate from $Pu(NO_3)_4$. Glove Box 222 contained a small oxidation furnace to convert oxalate to PuO_2; Glove Box 223 was used for plutonium powder inspection and in-process storage.

Three glass columns, approximately 36 inches tall by 5 inches in diameter, for ion-exchange recovery of plutonium, were located in Glove Box 231. Glove Box 233 contained glass columns for scrap dissolution in nitric acid, and Glove Box 234 was used for scrap classification and weighing. Glove Box 242 contained three critically safe stainless steel columns 5 inches in diameter by 78, 94 and 125 inches long for storage of ion-exchange feed solution. Four larger tanks, for storage of feed solution and waste, were located in Glove Box 241. These tanks had the following dimensions:

- o 24 inches diameter by 68 inches high
- o 24 inches diameter by 68 inches high
- o 30 inches diameter by 44 inches high
- o 30 inches diameter by 52 inches high

These tanks were of stainless steel construction, and filled with borosilicate Raschig rings. Another Raschig-ring-filled storage tank, similar in size to those above, was located horizontally in a glove box under Glove Boxes 231 and 232.

The analytical laboratories occupied the areas identified as "G" in Figure 1-1. Glove Boxes 151, 152, and 161 were used for sample preparation and spectrographic analysis of plutonium fuel materials. Glove Box 153, located in the same room, contained apparatus for gas analyses of fuel pellets and powder. In the other of the larger rooms comprising the analytical laboratories, there were five glove goxes, seven single fume hoods, and two double fume hoods. Glove Boxes 101, 102, 121, and 122 were used for impurity analyses and sample preparation. Glove Box 134 was used for plutonium powder characterization. The fume hoods, used for wet analyses of plutonium and mixed oxides in solution, were located along the east and south walls of the laboratory room. The small room to the west of this room contained equipment for performing nondestructive assays on for packaged waste.

In the remainder of the laboratory, Area D, Inspection (Figure 1-1), was used for nondestructive inspection of completed fuel rods, and Area H, the North Lab, contained a completely enclosed glove box line and sintering furnace for development associated with UO_2 processing and handling equipment. Plutonium-bearing materials were not handled in this line.

With the exception of the analytical laboratories' operations, all nuclear material was handled and processed in negative-pressure glove boxes. Material was bagged out of glove boxes in sealed packages when necessary for transfer. In the analytical laboratories, some operations were performed in open-faced hoods. Air flow into the hoods was maintained at greater than 100 feet/minute. Nuclear material was stored in double-bagged containers in the fuel storage vault at the north end of the laboratory; entry was from Area H in Figure 1-1. Area I was utilized during the decontamination operations for packaging of double-bagged containers of nuclear-bearing material in DOT-approved shipping containers.

1.3.4 Support Facilities

The penthouse, located over the main laboratory area, contained duct, final High Efficiency Particulate Arrestant (HEPA) filters, and exhausts for the ventilation systems which provided the negative atmosphere for the glove boxes. The laboratory's room air handling system and the associated HEPA filters were also located in the penthouse, as was a closed recirculating water cooling system used for process equipment in the laboratory. Some of the ducts and filters were highly contaminated; none of these systems was open to the penthouse.

The contiguous structure to the east of the laboratory contained offices, facility utility support equipment, locker rooms, and a health physics office. Entry to this area from the laboratory was through a connecting door; personnel were instructed to monitor clothing and shoes prior to leaving the laboratory and entering this area.

Laboratory coats, coveralls, and special shoes or shoecovers were worn by all individuals in the laboratory. None of these clothing items was permitted beyond the change room (Area L in Figure 1-1). The only known contaminated material permitted outside the laboratory, in other than sealed packages, was routine smear papers used by health physics personnel for evaluation of removable contamination. These smear papers were measured in the health physics office, Area N in Figure 1-1, and then returned to the laboratory for disposal. (Suspect high-level smears were evaluated in controlled areas, specially established in the laboratory, using equipment moved in from the health physics office.) The floors in the health physics office, locker room, and entry way into the laboratory were routinely surveyed for contamination on at least a daily basis.

Ventilation in the locker room and health physics office was provided by the laboratory's ventilation system. The office area and utility equipment area were isolated from the other laboratory areas by doors and were serviced by ventilation systems separate from that provided for the laboratory.

The only nuclear material allowed in Building 10, and outside the confines of the laboratory, was that packaged in containers suitable for shipment.

1.3.5 Facilities Equipment

1.3.5.1 Glove Boxes -- A standard glove box was used for many of the applications in the laboratory. This box, shown in Figure 1-8, was constructed of welded stainless steel -- the floor of 8 or 10 gauge and the top of 12 gauge. Windows were acrylic plastic (Plexiglass or Lexan). Safety glass windows were installed in the top, over which were mounted light fixtures to illuminate the glove box's interior. Each glove box contained its own inlet and exhaust so that it could be operated independently. Connections between glove boxes for material transfer consisted of plastic pipe approximately 18 inches in diameter. Plastic sleeving, .012 inch thick, was used around the pipe to provide a seal. Glove boxes could be isolated by removing the pipe and heat-sealing the plastic sleeve.

Larger glove boxes were installed where necessary to accommodate equipment and certain operations that needed more space. All of these glove boxes were of stainless steel of 8, 10, or 12 gauge thickness. A few of these boxes contained safety glass windows. Glove boxes in the analytical laboratories, and some of the special boxes, had rectangular cross sections rather than the sloped sides on the standard glove boxes. All process holding tanks were installed in large glove boxes; these included Box 233A (located under Boxes 231 and 232), Box 241, and Box 242. Other boxes in the Chemical Processing Laboratory were larger than the standard size to accommodate process equipment. In the Ceramic Fuel Processing Laboratory, Glove Box 400, Box 425 (the overhead transfer), and Box 420 were significantly larger than standard, as was Box 414 (the sintering boat conveyor). Air locks were mounted on the ends of some glove boxes; these were of heavy stainless steel construction, of approximately 1/4 inch wall thickness. A complete list of glove boxes, with dimensions and other pertinent information, is presented in Appendix A.

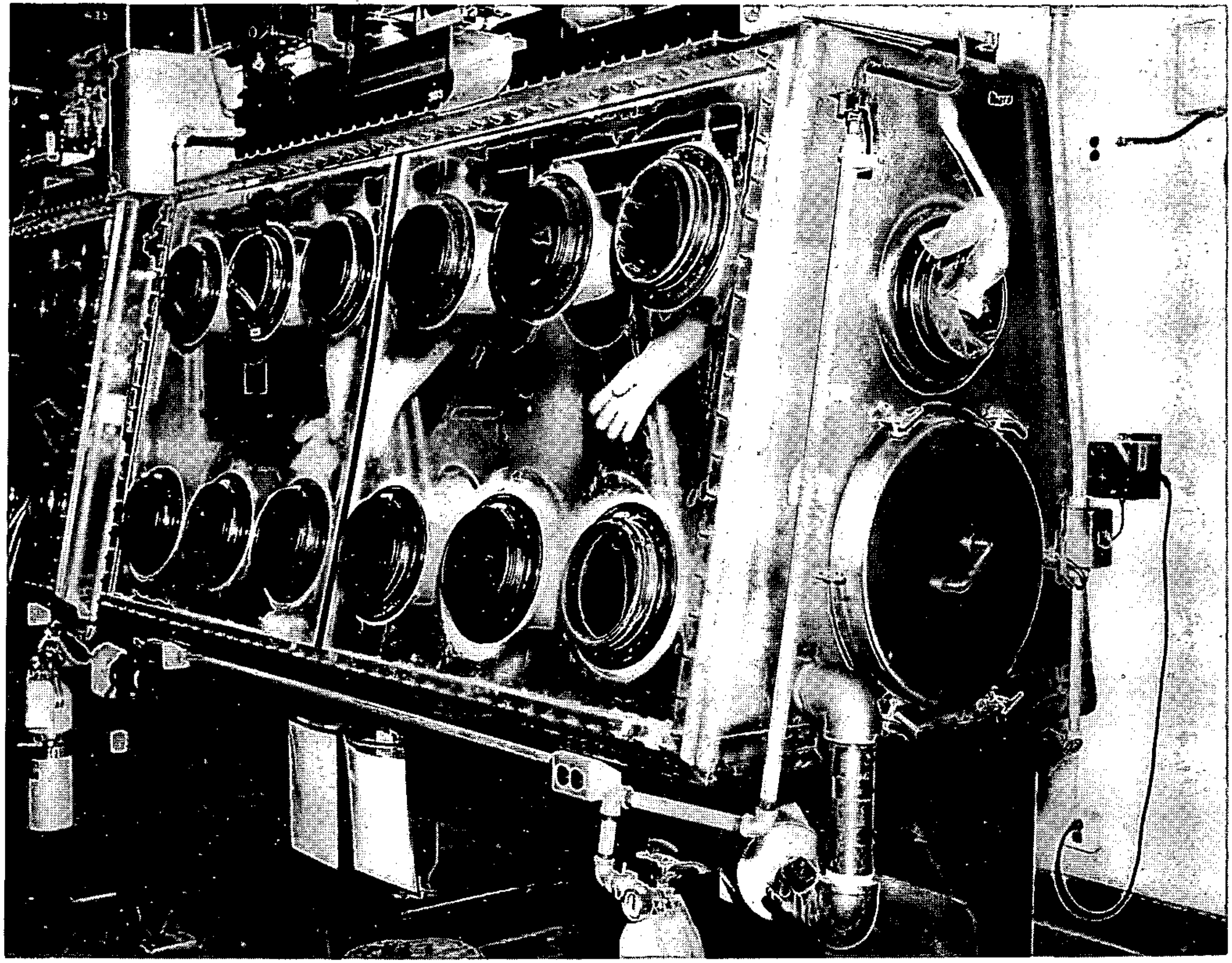

Figure 1-8. Typical Standard-Type Laboratory Glove Box

1.3.5.2 Glove Box Equipment -- Major equipment located in glove boxes was discussed in Section 1.3.3. In addition to this major equipment, many glove boxes contained smaller items, such as balances, sieve shakers, analytical apparatus, ultrasonic cleaners, and powder blenders. A list of all equipment related to the glove box operations is contained in Appendix A.

1.3.5.3 Fume Hoods -- Fume hoods in the analytical laboratory were constructed of lighter gauge sheet steel with Teflon-lined interiors. The vertical sliding doors were safety plate glass. There were seven single hoods 48 in. wide x 37 in. deep x 70 in. high, and two double-door hoods 97 in. wide x 37 in. deep x 70 in. high. Typical hoods are shown in Figure 1-9.

1.3.5.4 Glove Box and Fume Hood Ventilation -- Glove boxes were maintained at a negative pressure of approximately 0.7 inch of water. Each glove box was exhausted through four HEPA filters mounted in parallel within the box; duct from the glove boxes led to exhaust mains which fed into dual series HEPA filter banks located in the penthouse.

Fume hoods were exhausted through in-duct HEPA filters, which fed into the glove box exhaust mains.

Blowers were located on the clean sides of the final filters, which exhausted to the atmosphere outside the building through stacks.

Two exhaust systems were utilized to supply all glove box and hood exhausts. One system serviced the Fuel Processing, Chemical Processing, and Welding areas; the other system serviced the Analytical Laboratory's glove boxes and hoods.

1.3.6 Contamination Problems During Operations

As mentioned previously, the operating philosophy was to maintain a clean laboratory and immediately remove any contamination. Local contamination was occasionally encountered from glove changes, torn gloves, leaking hydraulic systems external to glove boxes, and similar occurrences. These involved only

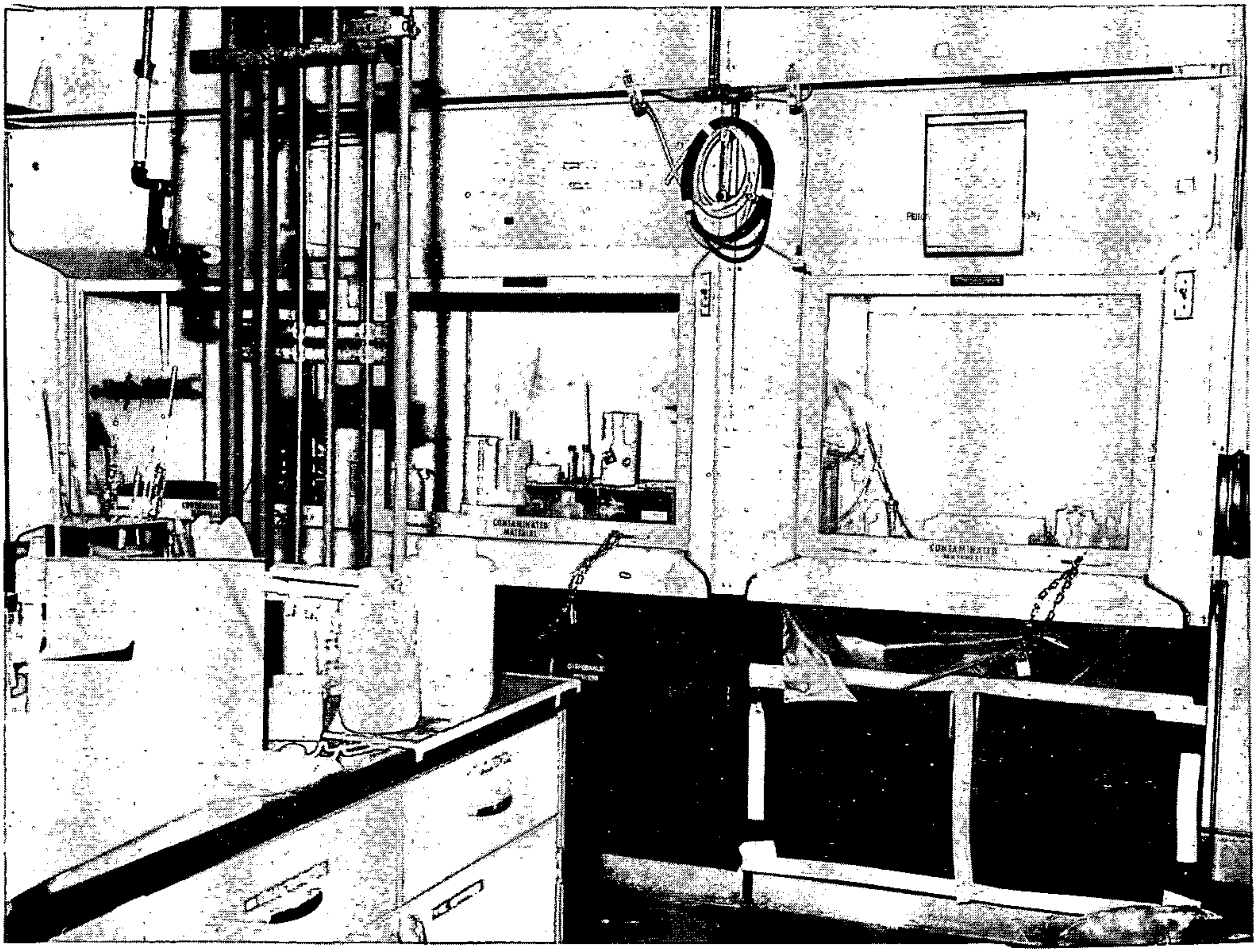

Figure 1-9. Typical Analytical Laboratory Fume Hood

small areas of several square feet of floor and equipment surfaces. More frequent local contamination was encountered in the Analytical Laboratory from small liquid spills originating in the open-faced hoods. Some of these spills resulted in fixed contamination of the concrete floor, under the paint, which could not be removed at the time.

There were two releases which involved more extensive areas: One release occurred in the Analytical Laboratory when a container of plutonium- bearing sludge, which had apparently been outgassing, was opened in a hood. The material splattered out onto the operator and the surrounding surfaces. The operator washed himself under an emergency shower in the Analytical Laboratory and the water spread contamination generally over the entire Analytical Laboratory floor and through an adjacent doorway into the Chemical Processing Laboratory. The other release occurred in the ARD Laboratory prior to the time it was used for Non-Destructive Assay (NDA) and storage activities. A furnace malfunction ejected plutonium contamination into the air, which resulted in contamination of most of the surfaces in that particular laboratory room. In both instances, the contamination was removed immediately. However, in the Analytical Laboratory, some contamination soaked into the concrete floor and was painted over.

SECTION 2
PROJECT SUMMARY

2.1 OBJECTIVES

2.1.1 Initial Work Scope

At the time the decision was made to decommission the PFDL facilities, an initial plan was established to provide direction for the activities and to identify those subjects which required a development effort. This initial plan was based on an engineering analysis of the undertaking by the PFDL Engineering and Operations staffs:

DECONTAMINATION AND DECOMMISSIONING WORK SCOPE

A. Summary

Detailed plans will be developed and procedures will be written to assure continuity in each phase of this activity. Clean, nonessential equipment and services will be removed from the laboratory as a preventative measure against contamination when full decommissioning operations begin. Contaminated equipment will be removed from glove boxes and packaged for disposal. The interior of the empty glove boxes and hoods will be decontaminated using special detergents, and painted to fix any residual contamination in place. Concurrent with these activities, part of the facility will be rearranged to accommodate a dismantling room. This dismantling room will be used for cutting or sectioning standard-type glove boxes and other contaminated items, allowing greater contamination control than in situ operations. In addition, special procedures will be required to handle some nonstandard enclosures and equipment, such as the glove boxes containing large, heavy storage tanks and the sintering furnace complex.

Upon completion of these activities, efforts will be concentrated on the facility. Air ducts, filters, and piping will be sectioned in place and packaged for disposal. The Penthouse area contains potentially contaminated exhausts, ventilation ducts, and filtration units which will require special procedures for surveying and handling, particularly in the removal of large equipment items, such as the cooling water system and acid storage tanks. The dismantling room will then be decontaminated and decommissioned. The final facility decommissioning activity will be removal of the suspect waste system with its associated underground tanks and piping, after which time the floor will be restored and both the floors and walls will be painted. A radiation survey will be required to release the facility for unrestricted use.

B. Planning

Detailed plans will be developed and procedures written. Equipment removal will be coordinated with the overall decommissioning program to be certain that equipment is not removed until the need for this equipment has ceased.

C. Removal of Noncontaminated Equipment (Nonessential)

1. Laboratory Equipment

All noncontaminated equipment will be disposed of per Westinghouse Corporate policies. All equipment which can be removed immediately will be identified and transferred to a storage location for eventual disposal. The removal of the remaining equipment items will proceed when they are no longer required for the operation of the facility.

2. Services

Services not needed during any operations will be identified, removed, cut up, and packaged for disposal. This action will be necessary to prevent these items from becoming contaminated in the event of a release during decommissioning operations. Services will include nonessential water, electrical, gas lines, etc.

D. Facility Rearrangement

Design and construction of a dismantling room will be required to handle all aspects of segmenting glove boxes and other contaminated items. A specific area of the laboratory will be designated to accommodate this specialized room. This will entail removal of all equipment and walls within the designated area.

E. Contaminated Equipment

1. Plutonium Contaminated Equipment

Equipment in glove boxes will be cleaned, disassembled as required, removed, nondestructively assayed (NDA), and packaged for disposal.

Equipment not easily removed from glove boxes using standard bag-out procedures will require special procedures, e.g., window removal in a constructed plastic tent.

2. Uranium Contaminated Equipment

All uranium-contaminated equipment items will either be disposed of as low specific activity (LSA) waste or dispositioned for use within Westinghouse or outside sources.

a. Equipment which may be of value to another Westinghouse facility will be identified and transferred to that location.

b. Arrangements will be made for the sale of any remaining equipment items that might be of interest to an outside customer.

c. The remaining equipment will be disassembled and packaged for shipment to a commercial burial site.

F. Glove Boxes and Hoods

1. Standard Operations

Operations for decontamination through shipment to disposal of plutonium glove boxes and hoods will involve approximately 65 NFD glove boxes and hoods. The following describes briefly the processes that will be required for completion of these operations in sequence:

a. Gross Decontamination of Glove Boxes and Hoods

Gross decontamination includes removal of macroscopic quantities of residuals by use of chemical reagents and wipes.

b. Final In Situ Decontamination

The interior of the glove boxes and hoods will undergo a final cleaning and washing process using special detergents to decrease the levels of contamlnation to the lowest level possible.

c. Painting

The interior of cleaned glove boxes and hoods will be spray painted to fix any loose contamination in place. Suitable fixatives will be evaluated.

d. Nondestructive Assay (NDA)

All glove boxes and hoods will be surveyed by NDA techniques.

e. Transfer to Dismantling Room

Glove boxes and hoods will be dismantled from their respective stands and supports, separated from the ventilation (exhaust header), and transported to the dismantling room.

f. Window Removal

In a specific area of the dismantling room, the windows of the glove boxes will be removed, wiped, again spray painted, segmented in pieces, and packaged.

g. Glove Box and Hood Sectioning

The glove boxes and hoods will be transferred through an air lock into the sectioning area of the dismantling room. They will be sectioned into specified pieces using nibblers, shears, sanders, bolt cutters, etc.

h. Packaging

The sectioned pieces will be transferred through an air lock to the packaging area of the dismantling room. The pieces will be wrapped in plastic, taped, and placed into the appropriate shipping packages.

2. Special Operations

Special procedures will be required for handling specific enclosures and equipment. Items requiring special procedures include floor-to-ceiling glove box structures containing large diameter, heavy-walled, stainless steel storage tanks and a large sintering furnace complex with integrated conveyor-glove box systems.

The glove box structures cannot be removed from their existing positions for sectioning in the dismantling room without removal of facility walls. The storage tanks contain boron-silicate glass rings and comprise a large area within these glove boxes. The tanks, because of their size and weight, cannot be readily removed without sectioning in place or the installation of special rigging.

The large sintering furnace complex with integrated systems must be dismantled in place using extraordinary procedures to prevent spread of gross contamination within the surrounding areas. The furnace is a three-section unit (preheat, main heat, and cooling zones) which will require separation. The main heat zone's brickwork will require removal and packaging. The integrated system will require the removal of cross members that tie in conveyors and glove boxes to the furnace unit. The size and weight of the furnace components present an additional handling impact.

A comprehensive design effort for handling and dismantling the above items will be required.

G. Facility Services

1. Plutonium Laboratory

Plutonium-contaminated duct, filters, and piping will be sectioned in place, further sectioned as required in the dismantling room, surveyed by NDA, packaged, and shipped for disposal to the burial site.

2. Penthouse

The Penthouse area of the PFDL contains a large segment of major vital systems for the facility, i.e., ventilation duct work, final filtration, recirculating water, etc. The Penthouse and its associated equipment items are classified in the contaminated, potentially contaminated, and noncontaminated categories. The filters will be classified as contaminated and subsequently packaged, surveyed, and shipped as such. Other items will be surveyed to determine their classification, and handling techniques will be accomplished accordingly.

Large items, such as the cooling tower and large noncontaminated reagent storage tanks, will require removal of wall or roof areas utilizing assisting cranes.

H. Dismantling Room Removal

After all operations are completed for the dismantling room, the room itself will be dismantled. Tents or greenhouse structures will be constructed to accomplish this operation. The components of the room will be decontaminated, sectioned, NDA surveyed, packaged, and shipped to disposal.

I. Final Facility Operations

1. Suspect Waste System

The suspect waste system for the facility consists of three tanks located underground and associated underground piping. Use of this system has been limited to potentially contaminated liquids. Most liquids collected and processed have been below the maximum allowable concentrations for discharge to the environment. Decommissioning of this system will consist of flushing the pipes and tanks, analyzing and processing the flush liquids, and monitoring interior surfaces of the system.

The floor areas will be scarified to remove the outermost layer of floor. The residues from the scarifying process will be collected, surveyed, packaged in drums, and removed to disposal. The floors and walls will be washed, liquid collected, surveyed, and sent to disposal.

The areas of the floor where the suspect waste piping is located will be dug up, the pipes sectioned, surveyed, and packaged for disposal. The floors will then be restored and a designated coating applied.

Considering the history of the system, it is unlikely that dismantling of the tanks will be required. However, if dismantling is determined to be advisable, the low levels of contamination involved are not expected to require extensive precautions or effort.

2. Painting

The walls and floors will be painted.

J. Final Health Physics Facility Survey

Upon completion of all work indicated above, a radiation survey of all the facilities will be completed. The facilities will then be released for unrestricted use.

2.1.2 Final Scope of Operations

The initial plan was generally adhered to throughout the entire decontamination and decommissioning operation. Details of the various operations will be presented in subsequent sections.

In the initial plan, it was indicated that a special dismantling room was to have been erected for the purpose of sectioning glove boxes and other equipment and for packaging the pieces for shipment. The first design of this dismantling facility called for a relatively complex installation consisting of three rooms: one for removing glove box windows, one for sectioning, and one for packaging. Walls were to be of rigid construction, with a fixed floor and ceiling in order to provide structural integrity for control of contamination. A separate HEPA ventilation system was to be provided because sufficient capacity was not available in the portion of the laboratory where there was adequate space for this dismantling facility. A new breathing air supply system had also been identified, as the existing system did not furnish a pressure adequate to meet the needs for upgraded respirators as specified by the Health Physics Department. Alternatives to this dismantling room design were explored for several reasons: 1) to reduce the volume of contaminated waste which would result from the materials and equipment used in the construction of the room, 2) to reduce the cost, 3) to reduce the time required for construction, and 4) to provide a more convenient location of the room.

Several changes were made in the concept as a result of this re-evaluation. Adequate ventilation was available in the Analytical Laboratory using the Analytical Laboratory's glove box ventilation system, provided that hoods and glove boxes were first disconnected from the system. A structure of flexible plastic sheet (.012 inch thick polyvinyl chloride (PVC)) could be constructed within the Analytical Laboratory. The Analytical Laboratory already contained the highest residual contamination of any laboratory area, so the possibility of additional contamination was less of a consideration. The existing breathing air supply system could be upgraded simply by installing a more powerful motor and operating the pump at a higher speed.

This revised concept of the dismantling facility was transformed to practice, and proved so successful that when all of the normal size glove boxes had been processed, a similar facility was built around the two large glove boxes containing liquid storage tanks for in situ dismantling. The same facility was also utilized for dismantling the remaining larger glove boxes which would have been difficult to move to the first dismantling facility. Ventilation for the second facility was obtained from the Chemical Process Laboratory's glove box exhaust system with an addition of a HEPA filter at the inlet. Sufficient experience had been gained with the operation of the first facility to estabblish that airborne contamination during the cutting and dismantling operations was not nearly as severe a problem as had initially been anticipated.

All remaining glove boxes were handled in the second facility, and all possible duct, filters, and filter housings were dismantled, sectioned, and packaged in this facility. This left the contaminated glove box exhaust system which serviced the second dismantling facility as the only remaining highly contaminated equipment. A smaller facility was erected with an independent ventilation system fabricated from noncontaminated equipment removed from another exhaust ventilation system. This third dismantling facility was used to handle the remaining exhaust system and other miscellaneous equipment.

The only other major deviation from the initial plan was the decision to raze the building once it was declared by the NRC to be decontaminated adequately for unrestricted use. This decision influenced the procedures for removal of facility equipment, and obviated the need for restoring the structure.

2.2 HANDLING OF EQUIPMENT FROM GLOVE BOXES FOR DISMANTLING AND DISPOSAL

The initial effort of the decontamination program was to remove all possible equipment from glove boxes in preparation for cleaning of the glove boxes. The contents of all glove boxes were reviewed and a plan was established for treatment of the various categories of equipment. The process liquid tanks were either to be dismantled and sectioned in place, or moved with the glove box to the glove box sectioning facility (see Section 2.8). Some equipment was to be partially disassembled, and large sections were to remain in the glove box (to be removed in the sectioning facility). Smaller equipment was to be disassembled, or cut apart, and removed from the glove boxes.

Decisions were based on the disposal requirements. All glove boxes had to be decontaminated to certain limits (see Section 2.4) in order to be shipped to the burial facility in corrugated steel boxes (CSBs). Therefore, it was necessary to remove all possible equipment to facilitate the decontamination of the glove boxes. All equipment too large to fit into a standard 55-gallon drum had to be decontaminated to the same levels as glove boxes since it also went in the CSBs. Items being shipped in 55-gallon drums did not require decontamination other than to remove gross quantities of material in order to meet a limit of 20 curies maximum for each drum. Decontaminating a smooth glove box surface was relatively simple compared to the effort needed to decontaminate a complex assembly of parts. Also, any inaccessible recesses or surfaces of equipment being shipped in CSBs was to be filled with a high-density foam in order to fix any contamination present.

The decision was made early in the planning to disassemble all possible equipment so that the pieces could be shipped in 55-gallon drums. A further size restriction was presented by the glove box access ports since the largest opening available was an approximately 18-inch diameter port, which frequently was accessible only after transferring an item through several glove boxes. The normally accessible ports in glove boxes were 8 inches in diameter; therefore, as much equipment as possible was to be dismantled to fit through an 8-inch port. The final determination was made by the operating foremen who judged the time required to dismantle equipment to fit through an 8-inch port against the time required to move larger assemblies to an 18-inch port with the attendant handling problems, packaging effort required, and potential hazards.

Equipment was disassembled as expeditiously as possible. Screwdrivers, "Vice-Grip" pliers, socket wrenches, Allen wrenches, and box and open-end wrenches were the most commonly used tools; hammers also played an important role. Most of the cutting was done with reciprocating power saws equipped with bimetal blades. Carbide abrasive blades were utilized for difficult-to-cut materials such as Inconel and hardened steel. Bolt cutters and hacksaws were also employed.

As equipment was dismantled, the few large pieces such as grinder bases which could not be practicably cut were set aside for decontamination and fixing along with the glove boxes. Contained liquids, such as hydraulic fluids, were collected and held for special treatment (see Section 2.13.2). Small pieces were collected in metal paint cans or cardboard ice cream containers. Larger pieces and assemblies were individually covered with thin foam padding, or blotter paper, and taped to blunt sharp edges. Each package was at least double-bagged as it was removed from the glove boxes. Glassware was placed in plastic bags, broken, and then placed in metal paint cans (PFDL Operating Procedures No. PFDL-OP-D-0821 and No. PFDL-OP-D-0838 generally cover these operations). Different types of waste were segregated (see Section 2.13.1) to conform to the shipping and disposal requirements. Puncture-resistent gloves, made of canvas with a rough rubberized outer coating (Nitty Gritty 66 NFW gloves, made by Best Mfg. Co., Menlo, GA) were worn over the glove box gloves by the individuals performing much of the disassembly and cutting work. These gloves were very effective, as no worker received a hand injury while wearing them. The gloves performed so well that the line operators wore them on their own without being constantly reminded by their supervisors.

After the equipment was removed from a glove box, all piping, conduit, electrical outlets, and other utilities were disconnected and removed. Usually, only the fire alarm heat sensor and the fire extinguisher nozzle and piping remained. If electrical power was needed, it was fed through an extension bagged onto a port of the glove box. Each glove box contained pipes which were welded through the glove box wall. These were cut first on the outside, with a set-up such as that used for the removal of piping from the Chemical Processing Area (Section 2.3) and sealed with plastic and caulk, or with compression pipe cap fittings (such as made by Swagelock). The pipes were then cut inside the glove box and similarly sealed. The glove boxes were then inspected and released for decontamination and fixing.

2.3 REMOVAL OF LIQUID PROCESS PIPING

The Chemical Processing Laboratory contained several thousand feet of pipe which was used to transfer plutonium nitrate among the various glove boxes and holding tanks in this area. Figures 2-1 and 2-2 show typical arrays of piping. The piping was stainless steel 3/4-inch to 2-inch diameter; all joints were welded. Much of the piping was located in horizontal runs over the glove boxes, with vertical drops to the glove boxes. Prior to removal, the piping had been flushed several times with nitric acid and with water. All lines were gravity drained into the glove boxes. The horizontal runs were surveyed with a Ludlum Micro-R meter (detecting gamma) for evidence of hold-up. Several low spots in individual pipes were detected in this manner, and were tagged for future precautionary measures.

Planning for cutting commenced with a visual inspection of all piping to determine where cuts were to be made. The objective was to make as few in situ cuts as possible, i.e., pipes were to be cut in lengths as long as could be handled. Once cut and removed, the long pipe sections were to be taken to a sectioning facility for further cutting to length for disposal. Cutting

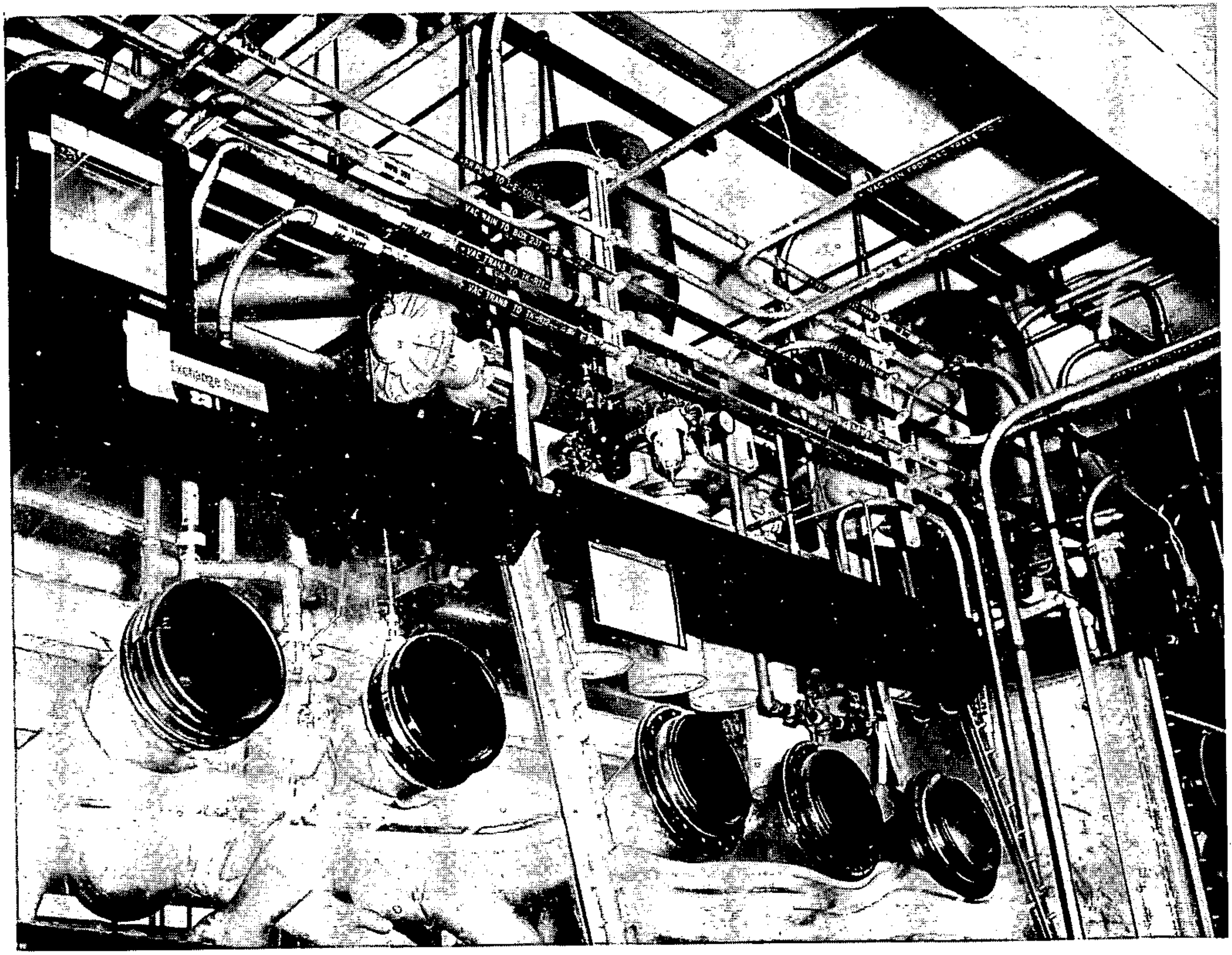

Figure 2-1. Overhead View of Typical Chemical Processing Glove Box Plutonium Nitrate Liquid Transfer Piping

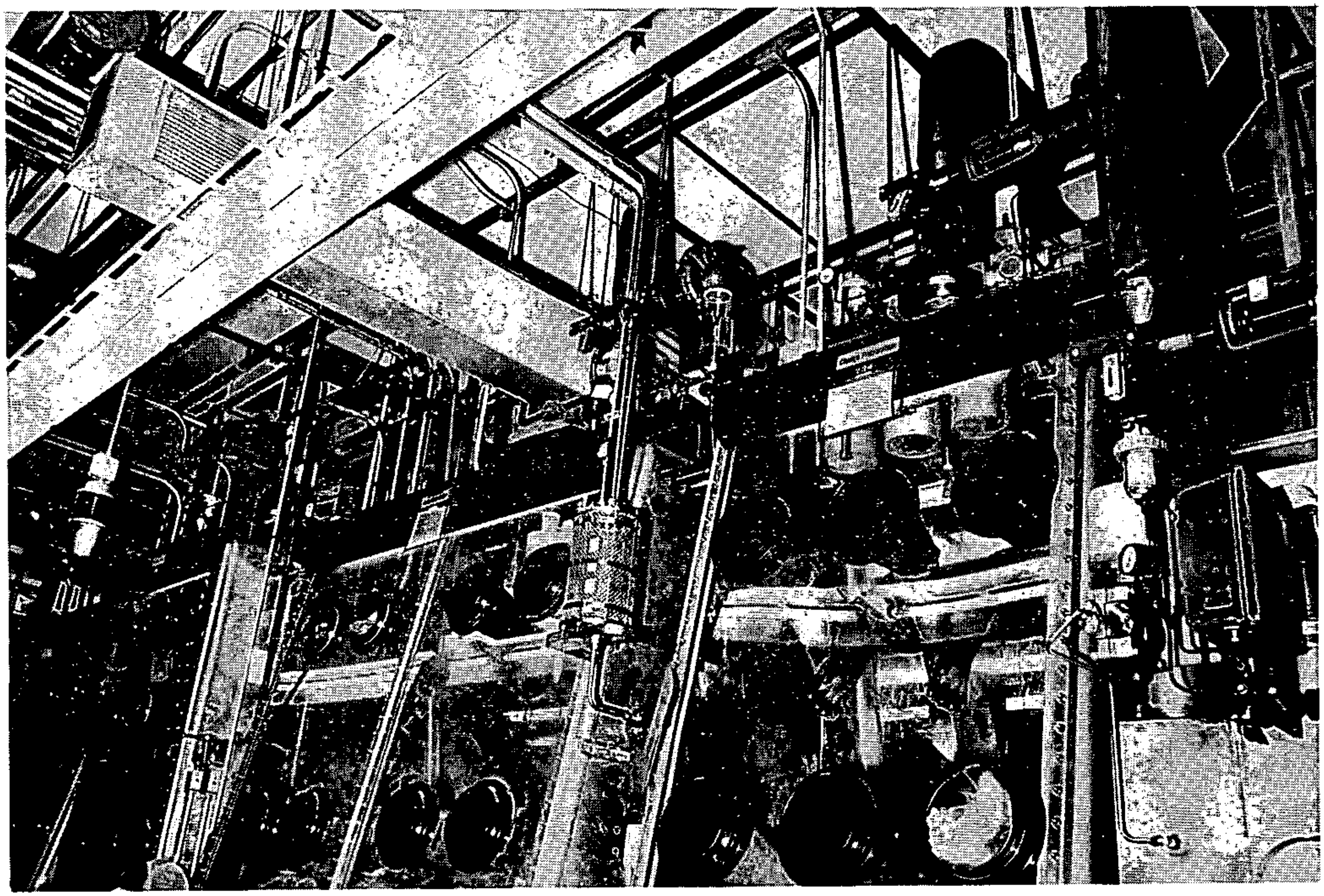

Figure 2-2. Overhead View of Typical Chemical Processing Glove Box Plutonium Nitrate Liquid Transfer Piping

locations were grouped together when possible so that one enclosure erected around the area would encompass several cuts. When these locations were identified, enclosures were constructed. The enclosures were made of 012-inch PVC suspended from whatever hardware was convenient; pipes to be cut were also suspended as required. The bottom of the enclosure was constructed of one piece of plastic formed to provide a pool to collect any liquid which might drain from the pipe; absorbent material was placed in the bottom. An opening in the enclosure allowed access to the cutting location; the enclosures were designed and placed so that all cutting could be done by an individual placing only hands and arms in the enclosure. A portable exhaust system was utilized to provide a flow of air through the enclosure. The exhaust system consisted of a HEPA filter connected to a 1,000 cfm blower. The HEPA filter was connected to the enclosure by means of 10-inch diameter flexible exhaust hose. The portable exhaust system was mounted on a cart for mobility, and surrounded with an enclosure to reduce the blower noise level. Room air ventilation outlets were blocked as necessary to prevent drafts which could spread airborne contamination.

The basic tools used for cutting the pipe were hacksaws and tubing cutters. Hacksaws were stock 12-inch frames; bimetal blades were used, as they were found to retain their sharpness much longer than one-piece blades. Tubing cutters were used wherever there was room for the swing; four-wheel cutters were chosen since they required turning through only about 100° of arc. Power saws were not used in order to minimize vibration, chip dispersion, and mechanical shock when the cut was completed. Plastic covers to fit over the ends of the pipes were prepared ahead of time from heat-sealed .012-inch PVC.

Power hydraulic shears were investigated as a possible improved method for cutting pipes. It was also thought that they might squeeze the pipe ends together. However, the shears were found to be heavy and unwieldly, especially for use on a scaffold or ladder. Another drawback was the sudden jolt as the pipe was cut through; the pipe required restraint in order to prevent whipping. Cut ends were not squeezed closed on the stainless steel pipe. Both types of shears were evaluated -- the scissor type and the pinch type.

Full protective clothing was worn by the individuals performing the cutting. This consisted of two coveralls (the outer one disposable), double shoe covers, triple gloves, a head cover and hood, and a full face respirator. The actual cutting team consisted of two operating technicians and a health physics technician; other individuals were used for various support functions.

Continuous alarming air monitors were located in the immediate work area, set to alarm at the proper level for the air respirators being used. Personnel were instructed to leave the area if the alarm sounded, and to evaluate and rectify the situation prior to resumption of cutting. Normally, a filtered air respirator was worn; forced air respirators were only to be used if the air count remained above the safe level for filtered air respirators.

The sequence of cutting was determined according to the accessibility of pipes; when possible, known or apparent low spots in horizontal lines were cut first. The procedure for horizontal lines was to cut into the pipe from the bottom to allow any contained liquid to drain before completing the cut. When a pipe was cut, the opening was caulked with a silicon seal and the exposed ends were then covered with the prepared plastic covers taped in place. The long pipe lengths which were removed from the pipe array were transferred to another facility where thev were cut, drained, and further cut into short lengths for disposal. PFDL Operating Procedure Number PFDL-OP-D-0857 describes the procedure for cutting the pipes.

The cutting operations were accomplished with a minimum of perturbations. The planning and procedures as described here were sufficient for all of the situations encountered. Occassional liquid release did occur, and for the most part these were contained in the enclosure. Several times, liquid splashed outside of the enclosure. When this happened, whether or not the air monitor alarmed, the personnel immediately left the area and discarded contaminated clothing. The area was then re-entered, decontaminated, and cutting operations were resumed. All of these releases were confined to local areas in the vicinity of the cutting enclosure; there was no general contamination of the room at any time.

2.4 DECONTAMINATION OF GLOVE BOXES AND HOODS

2.4.1 Procedure Development

Requirements for decontamination levels to be achieved on glove boxes and hoods were dictated by the shipping specifications. Since most of this type of equipment was shipped in corrugated steel boxes (CSBs), those limits were established. Briefly, surface removable contamination was to be reduced to 150,000 α dpm/dm^2, or to where successive decontamination operations did not reduce the average to less than 90 percent of the previous average. Contamination was to then be fixed by a suitable agent; the maximum allowable surface removable contamination after fixing was 10,000 α dpm/dm^2 (refer to PFDL Operating Procedure Number PFDL-OP-D-0848).

The first step in glove box decontamination was to remove all equipment, as discussed in Section 2.2. Gross decontamination consisted of removing all visible surface dirt, the objective being to achieve a shiny metallic surface. Starting conditions of glove boxes varied from being heavily coated with cement residue, from waste solidification operations, to being visually clean. Anticipated areas of difficulty included the window gaskets, the glove port rings, the filter housing recess, and the isolation door assemblies at each end of the glove box.

Initial effort in cleaning a dirty glove box was directed toward removing the surface dirt by scraping, wiping, abrading, and brushing. This was performed manually for the most part; occassionally a wire brush mounted in a drill motor was utilized. It was found that with the relatively awkward working positions involved when working through glove box gloves (see Figure 2-3), the use of hand-held power equipment was quickly tiring and sometimes dangerous. Scrapers, brushes, and other tools were affixed to extension handles in order to reach recesses; the ever-useful worm-drive hose clamp was extremely handy for attaching the extensions. Putty knives, paint scrapers, and screwdrivers were used for scraping. Abrading materials used included wire brushes, plastic bristle brushes, and Scotch-Brite abrasive pads. Absorbent paper wipes were utilized for surface cleaning. Liquid cleaners were investigated;

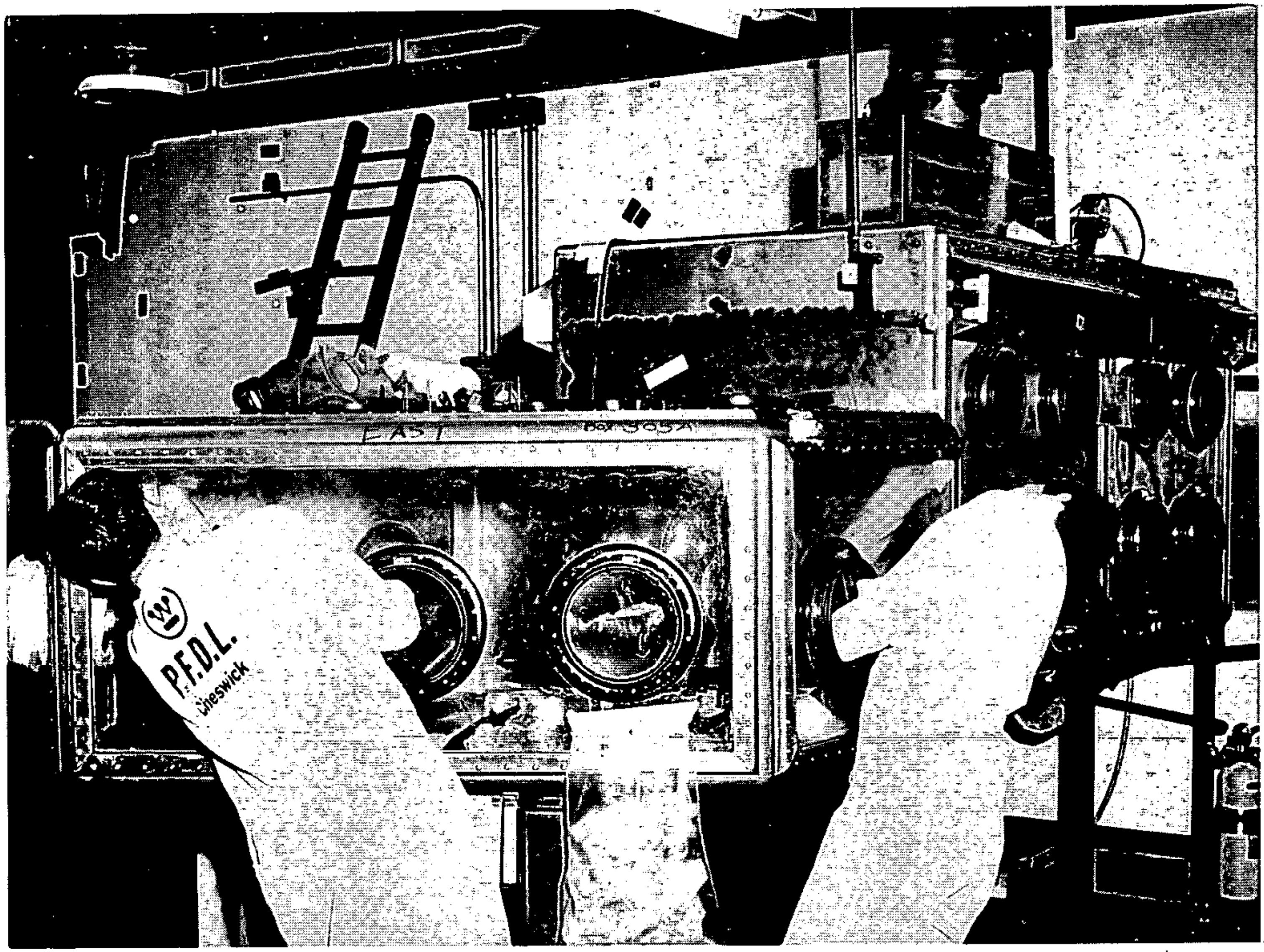

Figure 2-3. Technicians Cleaning Ceramics Laboratory Glove Box

NUTEC 600 EL was found to be very successful in removing dirt, grease, and radiological contamination from surfaces and recesses. The NUTEC was liberally applied from hand-operated spray bottles, and used with abrasive pads and wipes. Cleaning solutions sold by TURCO, and commercial powdered cleansers (such as AJAX) were not as effective as the NUTEC/abrasive pad and wipe combination.

Liquid residuals were collected in containers and solidified for subsequent disposal.

The procedure for gross contamination consisted of repeated cleaning until there was no visible dirt and the cleaning solution showed no discoloration. The interior isolation doors were removed to eliminate them as a source of contamination hold-up. The transfer tunnels connecting the glove box to adjacent boxes (18-inch diameter rigid plastic pipe contained inside plastic bags affixed to bag ports on each glove box) were removed and new bags were installed on the transfer ports, thus isolating the box being decontaminated.

During the gross decontamination of a glove box, three of the four HEPA exhaust filters were removed, the inlets were blanked off, and the fourth filter was replaced with a clean filter.

Repeated thorough flushings of window gaskets and glove port rings did not always prove adequate to remove the loose contamination as measured by alpha smears; although there was no visual contamination, there was an apparent tendency for these corners and recesses to retain some contamination which would spread if it was disturbed once it was dry. If after several attempts at decontamination the problem still persisted, the corners were sealed with a silicon-base caulk such as GE SILASTIC or DOW RTV. As the procedure was developed and the technicians gained experience, it was possible to determine subjectively by the degree of shine on the metal surfaces when additional cleaning would cease to be beneficial. Also, once the cleaning liquid failed to show discoloration when sprayed around windows and glove ports, it was found that no further significant reduction in contamination could be achieved in those areas. Near the time that it appeared that a box was clean, all old gloves and bags were removed from the glove ports and clean gloves, bags, and bag stubs were installed in locations as needed. If the exhaust filter appeared dirty, it was changed again.

When this status was reached in the decontamination of a glove box, the interior would be allowed to dry, and it would be checked for loose contamination. If the level was below 150,000 α dpm/dm^2, the glove ports and windows would be caulked and the box would be prepared for fixing. Contamination levels above 150,000 α dpm/dm^2 necessitated additional decontamination steps until the level was lowered sufficiently, or until the level failed to decrease by more than 10 percent.

Final fixing was accomplished by spraying with a quick-drying nonflammable coating; the commercial name was OAKITE CLEAR COAT. The primary ingredient of this coating material was a polyvinyl alcohol. Spraying was done using a standard compressed air paint sprayer (BINKS Model 62). Spray gun nozzles were affixed to plastic bag stubs on the glove box glove ports; at least one nozzle was mounted in this manner on each side of a glove box for the purpose of spraying the interior of the glove box. With this method, the spray gun was not exposed to the contaminated glove box atmosphere. After decontamination of a glove box and verification that the loose alpha contamination had been reduced to acceptable levels, all interior surfaces of the glove box were sprayed. Care had to be taken to minimize the spray onto the filter; after each spraying, the pressure drop instruments across the filter were checked to determine if the filter was clogged. If so, the filter was replaced to minimize drying time. Prefilters were frequently used to mini- mize or eliminate spraying directly onto the filter. Once the fixing was complete, the glove box was disconnected from all utilities and removed from its position in the glove box line. A disconnected glove box, awaiting dismantling, is shown in Figure 2-4.

As the fixing operation progressed, a technique was developed which provided the most optimum results. After final decontamination, a glove box was sprayed lightly -- the object being to avoid runs. After one to two hours of

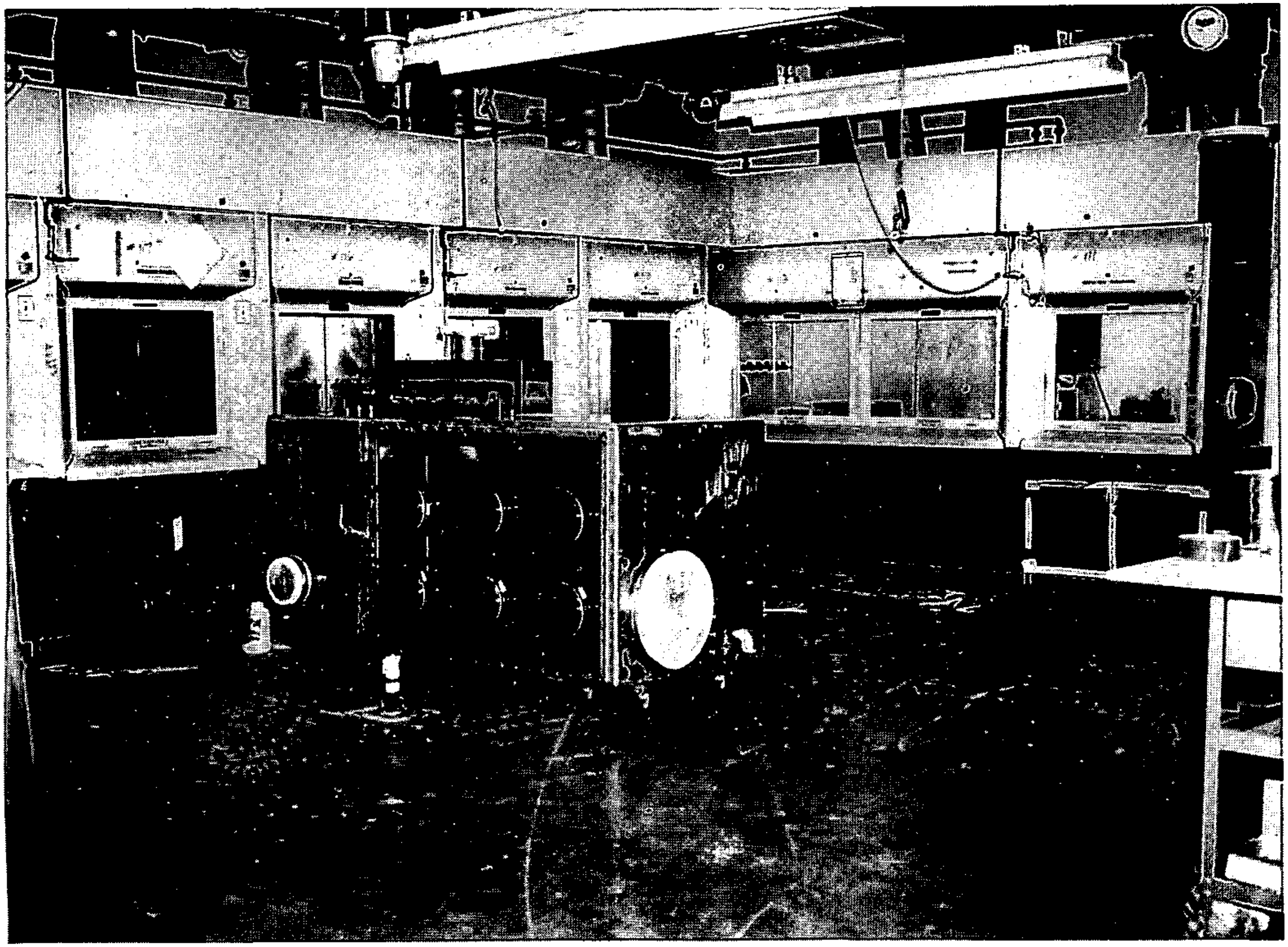

Figure 2-4. Analytical Laboratory Glove Box After Decontamination and Disconnection, Prior to Dismantling

drying time, it was lightly sprayed again. This was repeated a total of four times (usually in an 8-hour work shift). After drying for one or two days, the contamination level was checked, and if necessary, the procedure was repeated. Initially, the tendency was to spray heavily, but this resulted in an accumulation of the fixing agent on the floor of the glove box which caused two problems: 1) excessive drying time of several days, and 2) the thick coating interferred with the functioning of the metal cutting equipment utilized for the subsequent sectioning operations.

2.4.2 Development Survey Data Results

Table 2-1 shows the effect of each decontamination step on resulting contamination levels of several glove boxes decontaminated and fixed near the inception of the procedure. These data are typical of later results, with the exception that in normal practice the fixing operations were terminated once the required maximum allowable level of 10,000 α dpm/dm^2 was achieved. Also, early in the process two glove boxes, Numbers 302 and 303, were prepared for use in decontaminating equipment. As part of this preparation, detailed observations were made as to the effectiveness of the decontamination and fixing techniques and associated problems. Following is a summary of this work, prepared at the time the effort was concluded:

TABLE 2-1

SURVEY RESULTS AFTER EACH DECONTAMINATION AND FIXING STEP OF GLOVE BOXES DURING THE PROCESS DEVELOPMENT EFFORT

Glove Box No.	Location	Average of Removable Alpha Contamination Survey Results (1,000 dpm/100 cm^2)								
		Initial Survey	After 1st Decon	After 2nd Decon	After 3rd Decon	After 1st Fix	After 2nd Fix	After 3rd Fix	After 4th Fix	After 5th Fix
134	Chem Lab	>1,000	135	-	-	8	-	-	-	-
121	Chem Lab	>1,000	180	71	83	6	6	8	2	4
601	Met Lab	261	69	-	-	7	2	-	-	-
602	Met Lab	-	30	-	-	3	2	-	-	-
304	Ceramics Lab	-	209	53	-	16	9	3	-	-

PRELIMINARY DECONTAMINATION OF GLOVE BOXES NO. 302 AND NO. 303

Initial decontamination efforts for Glove Boxes No. 302 and No. 303 were directed at preparing these boxes for use in decontaminating and fixing equipment items from other areas of the laboratory. These boxes were chosen for this effort because they are isolated from the remainder of the laboratory and their use would not interfere with other D&D activities. They are also connected with Glove Box No. 301 which contains a compactor. These boxes will be among the last ones removed.

Because these boxes were used to process PuO_2 powders and were, therefore, highly contaminated, the effectivensss of the decontamination techniques could be better judged. The floor of Glove Box No. 303 was decontaminated several times with good results, but high activities were encountered in varying areas. This problem was traced to the gaskets on the glove ports and windows. Flushing these areas with the decon solution showed that the rubber was brittle and deteriorated. Repeated flushings continued to remove particles of the gasket, primarily from the glove ports. Caulking was applied to prevent further deterioration of the gasket. This appears to have been effective. Also, high counts were observed on the walls, and a fixing agent was applied. Continued high counts in Glove Box No. 303 were attributed to contamination from the pass-through tunnels, which must be replaced prior to use as a decontamination/fixing box.

By using the observations from Glove Box No. 303, Glove Box No. 302 was decontaminated to similar levels with fewer decontamination cycles. Smear data for both boxes are summarized in Table 2-2 for Glove Box No. 303, and in Table 2-3 for Glove Box No. 302.

Final decontamination of Glove Boxes No. 302 and 303 will require the removal of the fixing agent, which was applied in selected areas, prior to decontamination to disposal levels.

2.5 DISMANTLING FACILITIES

Dismantling facilities, which were basically tents, were constructed in three different locations within the laboratory for the purpose of sectioning contaminated equipment. The framework of the tents was 2 in. x 2 in. lumber; the length, height, and width were determined by the size of the various pieces of equipment that were to be sectioned. The framework of the tent was covered with .012-inch polyvinyl chloride (PVC) plastic sheet stapled to the 2 in. x 2 in. lumber. The 012-inch PVC plastic was used both inside and outside the tents. All overlapping seams of the PVC plastic sheating were taped with a

TABLE 2-2

DECONTAMINATION PROCESS DEVELOPMENT
SMEAR DATA FOR GLOVE BOX NO. 303
(1,000 dpm/100 cm^2)

Sample No.	10/19	10/20	10/21*	10/21*	10/22	10/26	10/29	10/30	11/2	11/3	11/13
Floor #1	125	280	555	407	153	147	50	26	-	-	143
Floor #2	183	75	226	94	51	80	27	11	-	-	89
Floor #3	154	7	276	355	222	122	90	66	-	-	191
Floor #4	295	185	203	200	63	69	21	23	-	-	145
Floor #5	392	87	344	101	30	177	12	24	-	-	85
Floor #6	616	143	660	207	51	34	72	21	-	-	154
Floor #7	1,152	203	978	93	51	77	18	25	-	-	90
Floor #8	117	121	622	93	45	117	18	20	-	-	108
Floor #9	331	243	305	78	124	187	139	18	-	-	-
Floor $\overline{X}$	374	149	463	181	88	112	50	26	-	-	126
East Wall	587	279	-	-	-	331	510	1,100	-	42-290	75
West Wall	302	133	-	-	-	37	753	151	-	30-318	87
North Wall	-	-	-	-	-	363	3,800	99	24	-	28
South Wall	-	-	-	-	-	519	662	249	72	-	51
Tunnel 302/303	-	-	-	-	-	-	-	-	-	-	1,500

10/19/82 - Entire box was scrubbed with NUTEC and scouring pads followed by a water rinse and wipe.
10/20/82 - Repeated process of 10/19/82.
10/21/82* - Repeated process of 10/19/82 on floor only (walls were not disturbed). RTV caulk was applied to one glove port.
10/21/82* - Box was wiped.
10/22/82 - Repeated process of 10/19/82 on floor only.
10/26/82 - RTV was applied to all glove ports and window gaskets. Box was wiped.
10/29/82 - Walls were cleaned.
10/30/82 - Fix was applied to the north and south walls. Floor was wiped.
11/2/82 - Additional fix was applied to the north and south walls.
11/13/82 - Box was wiped. Increase in contamination was attributed to disturbance of the transfer tunnel and doors.

*This box was smeared twice on 10/21/82.

TABLE 2-3

DECONTAMINATION PROCESS DEVELOPMENT
SMEAR DATA FOR GLOVE BOX NO. 302
(1,000 dpm/100 cm^2)

Sample No.	11/10/82	11/11/82	11/12/82	11/13/82
Floor #1	93	42	56	42
Floor #2	102	18	98	12
Floor #3	17	7	36	5
Floor #4	9	17	86	17
Floor #5	19	4	47	2
Floor #6	48	27	14	14
Floor #7	57	114	50	46
Floor #8	75	27	38	18
Floor $\bar{X}$	53	32	53	20
East Wall	27	29	29	22
West Wall	37	11	77	13
North Wall	882	761	2,100	125
South Wall	580	148	89	30

11/10/82 - Entire box was scrubbed with NUTEC and scouring pads followed by water rinse and wipe. Glove ports and window gaskets were flushed and sealed with RTV.

11/11/82 - Process of 11/10/82 was repeated (the RTV was not disturbed).

11/12/82 - Fix was applied to the north and south walls.

11/13/82 - Additional fix was applied to the north and south walls. Box was wiped.

cloth-backed tape. The framework along the floor was sealed with RTV caulking sealant, then taped. Figure 2-5 shows a dismantling facility under construction. Figures 2-6 and 2-7 show the typical layout of a dismantling facility, and the traffic-flow and air-flow arrangements.

Each tent was constructed with three rooms. The main room was a large area in which the glove boxes, duct, and filter housings were sectioned. Equipment in this room included the following:

- Dismantling tools, including nibblers, reciprocating saws, and hand tools

- Extension cords

- Foam generator for filling inaccessible cavities: Certain pieces of equipment had portions which were inaccessible for decontamination. Once in the tent, the inaccessable portions of this equipment were foamed using a foaming unit located outside the tent, and with hose cables leading to the inside of the tent. Upon completion of the foaming operation, the hose cables located inside the tent were scrapped.

- Consumables, such as tape, padding, wipes, and plastic

- Table, on which tools were laid out

- Small floor crane of 1,000-lb capacity

- Dollies

- Platform ladder

- Stools and small ladder

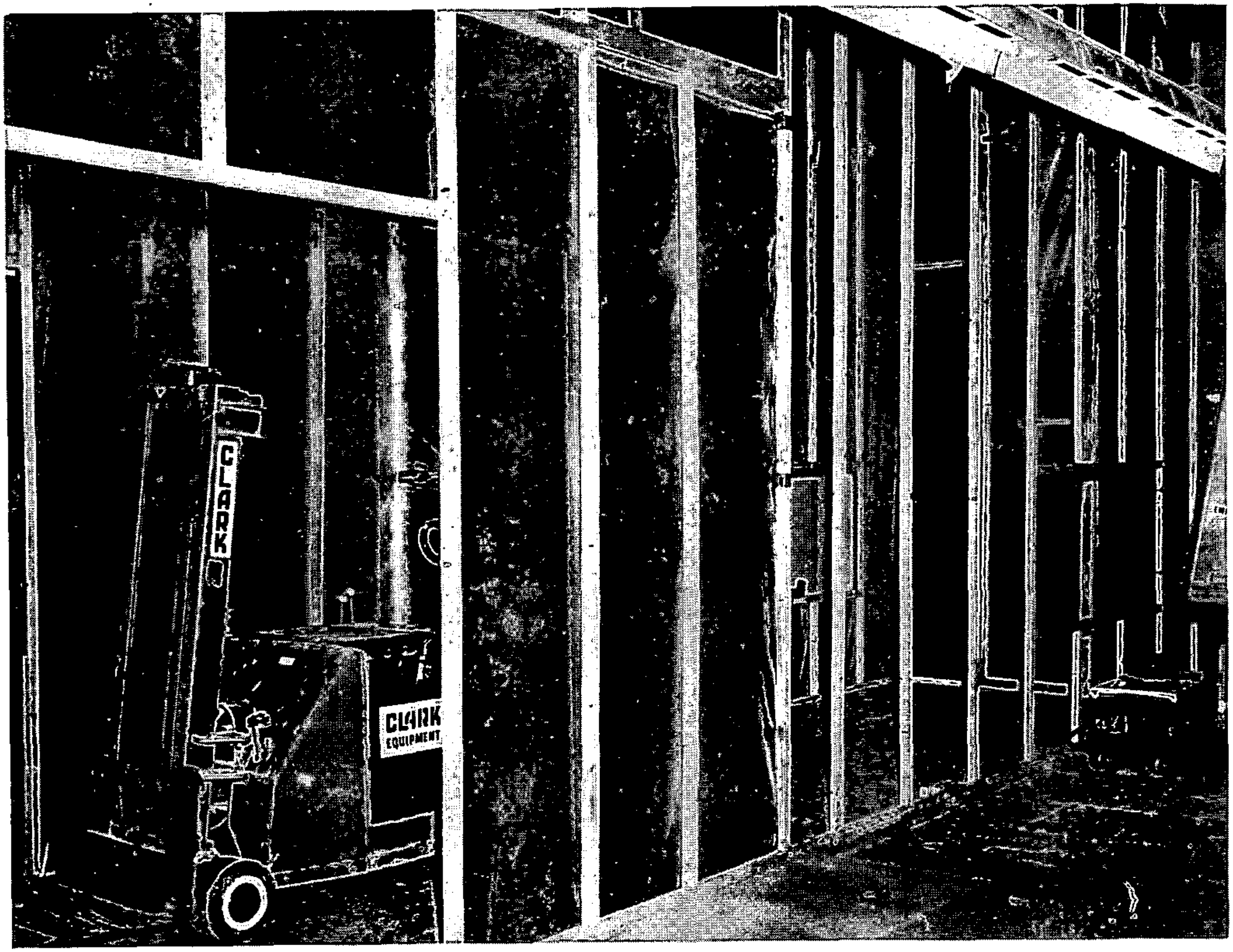

Figure 2-5. Construction of a Typical Dismantling Facility Showing Plastic Covered Framework Construction

SECTIONING AREA

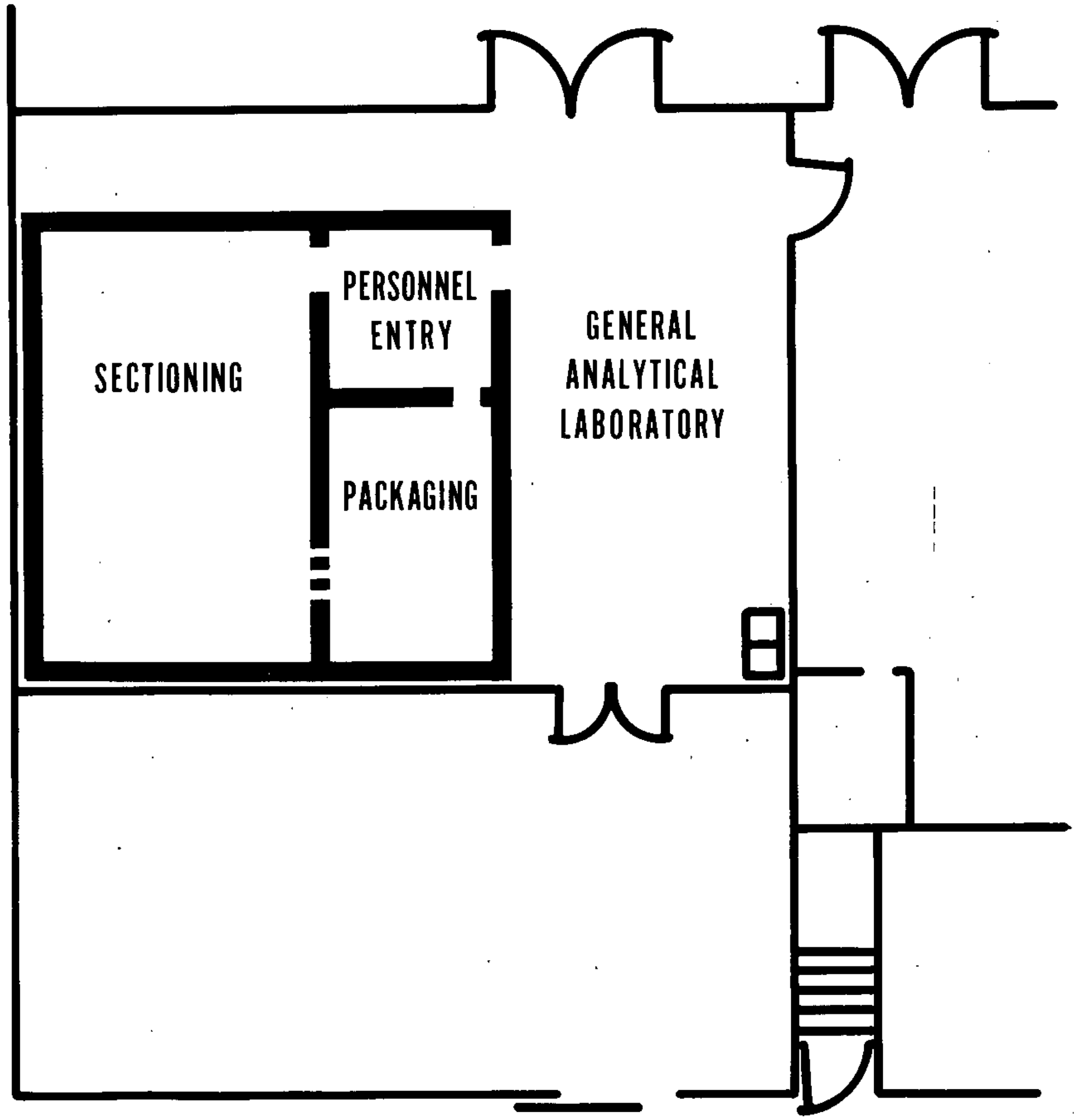

Figure 2-6. Typical Dismantling Facility Layout
Showing Functional Areas

TRAFFIC FLOW AND AIRFLOW

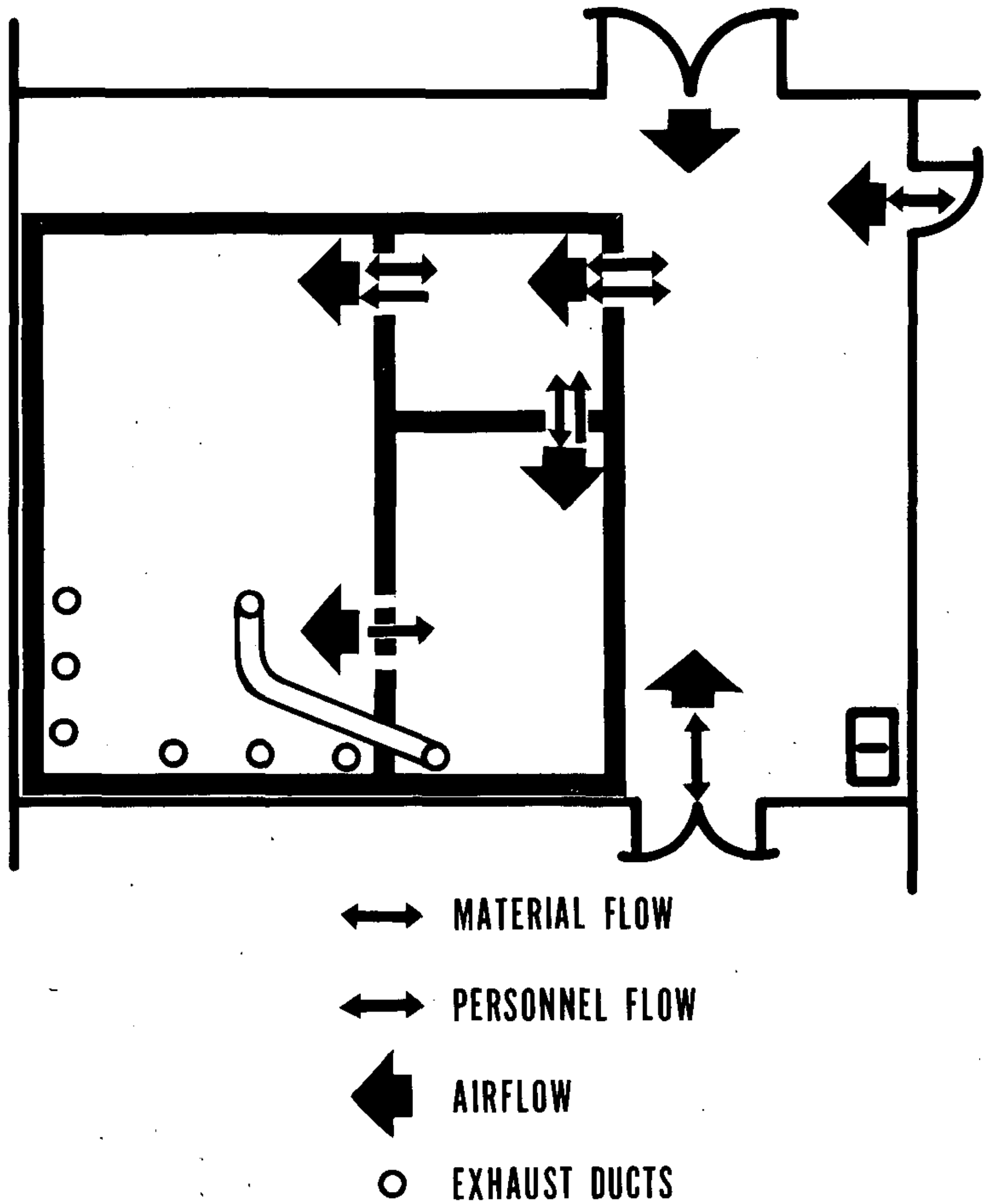

Figure 2-7. Typical Dismantling Facility Showing Flow Patterns

A small entry room was used as a first step-off area when coming out of the main tent area. The entrance room contained large bags of paper coveralls, shoe covers, gloves, etc., and alpha survey equipment.

The third room was used to package and seal sectioned equipment prior to its transfer to the NDA area. The size of this bag-out area was large enough for a table, plastic welder, two personnel, and the necessary supply of .012-inch PVC plastic sheet. Personnel access to this area was from the entry room. Covered openings were provided in the wall between the sectioning room and the packaging room, and in the wall between the packaging room and area outside the dismantling facility, to allow for transfer of packages.

Two of the three sectioning tents which were erected had floors constructed of 3/4-inch tongue-and-groove plywood sheets. PVC plastic sheets were placed under the plywood to prevent contamination from contacting the cement floor. The plywood was painted to allow for a smoother surface for routine cleaning. The third sectioning tent floor consisted of three layers of .012-inch PVC plastic sheet, one layer of blotter paper, and then two layers of .012-inch PVC plastic sheet on top.

Each sectioning tent was connected to an absolute-filtered ventilation system. This allowed the tent to always be operated at a more negative pressure than the area directly outside the tent. Routine checks by the Health Physics technician insured that the direction of air flow was always into the tent and at a rate of at least 100 feet per minute. A prefilter was located in front of the main filter opening to minimize plugging of the main filter.

The main sectioning room in two of the three tents was equipped with chains through the plastic roof attached to the structure of the building to allow for the lifting of heavy pieces of equipment; the third tent did not have this capability because of the type of equipment being handled.

While operations were being performed in the sectioning tent, a Health Physics technician was always located outside the tent in a central communication center, as shown in Figure 2-8, where he could observe the activities going on

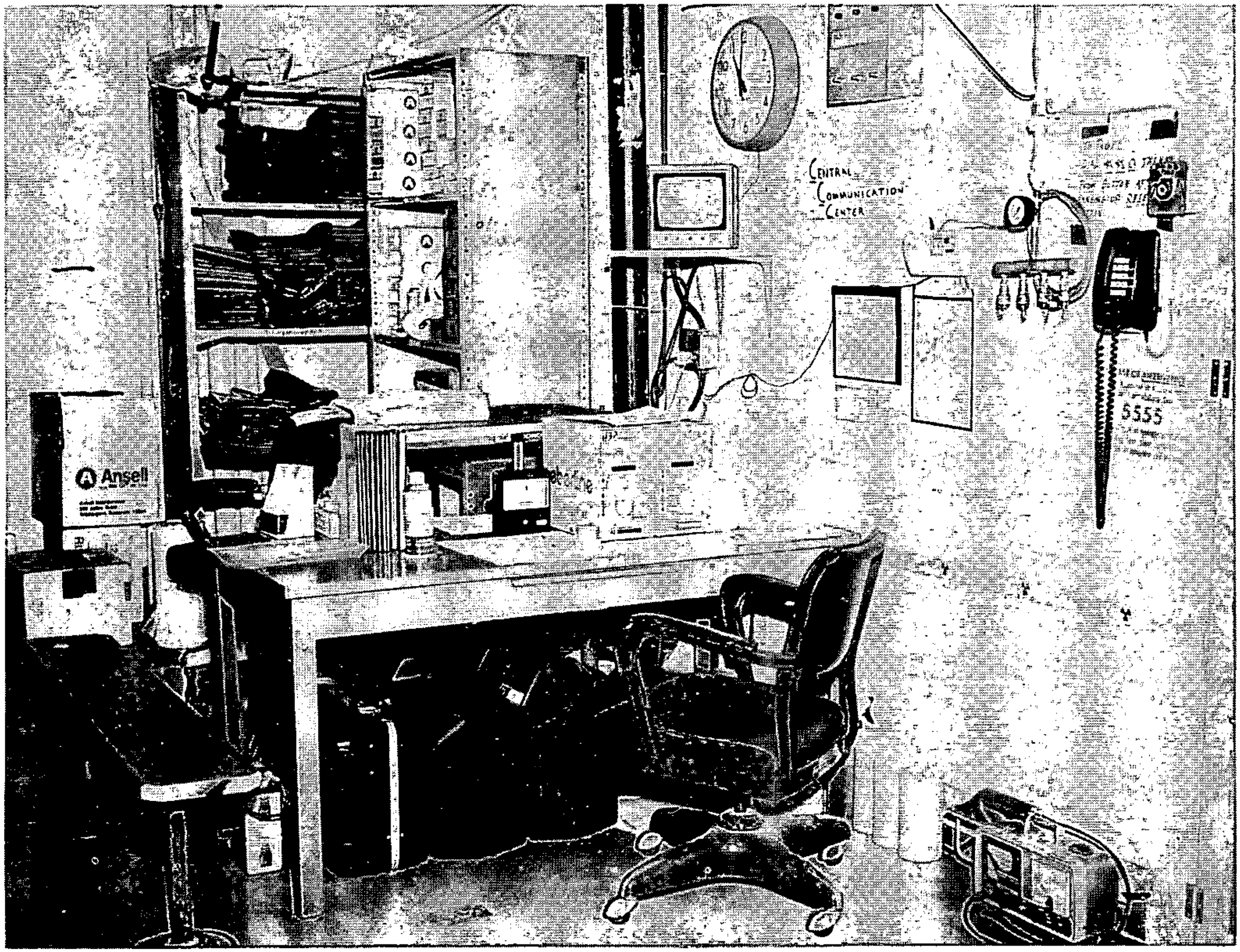

Figure 2-8. Typical Central Communications Center Located Outside a Dismantling Facility

within the sectioning tent by means of a closed circuit TV system. The camera used had a wide-angle lense installed to allow for maximum coverage within the tent. Other items located in the central communication center were an intercom system allowing direct communication with personnel inside the tent, health physics counting equipment, a clock, lights (both inside and outside the tent) connected to the plant's backup emergency generator system, and a telephone with emergency numbers prominently listed. All personnel working inside the tent were supplied with breathing air from the plant breathing air system; this system had operating alarms at various locations, including one in the central communication center. Provisions were made for five or six people to be supplied with breathing air. Each person had an air hose approximately 50 feet in length. During the sectioning operations, the air hoses were routinely wiped down to avoid the spread of contamination throughout the tent.

Removal of all the tents was basically accomplished in the same manner. Once all the equipment had been removed, the entire inside surface of the tent was wiped down with a decontamination solution; this included the ceiling, walls, and floor. After a check by the Health Physics technician verifying that the contamination levels were acceptable, the top layer of the floor was removed and disposed of. In the case of the two tents that had a plywood floor, the plywood was removed, leaving the top layer of PVC. At this point, the pre-filter on the ventilation system was changed. An additional wipedown was now done, followed by a complete survey by the Health Physics technician. Any remaining areas of contamination were cleaned to acceptable levels.

During the cleaning of the inside portion of the tent, personnel were still required to wear protective clothing and use supplied breathing air. Precautions were taken to avoid spreading of contamination throughout the tent when the breathing air hoses were dragged over the floor.

With the inside PVC plastic surface of the tent cleaned to acceptable levels, the inner PVC walls were removed and packaged for burial. During this period, the Health Physics technician continued to survey the area to insure that any contamination which may be uncovered was dealt with immediately. While this was being done, all personnel wore full-face filtered air respirators which were no longer connected to the supplied air system.

The outside layer of PVC plastic and the wooden framing were surveyed to assure contamination levels were acceptable, removed, and the entire area in which the tent had been located was surveyed.

As indicated earlier, the dismantling facility tent was equipped to supply five or six people with breathing air. The manifold for the breathing-air hoses was located in the small entrance area just inside the tent. One problem encountered in all the tents was entanglement of air hoses on the floor. To minimize this, one person routely performed the same operation in the same position in the tent, i.e., one technician would run the nibbler from the left side of the glove box and then transfer the nibbler to a technician on the right side of the glove box. All supplied air hoses were black, which made trying to untangle them in the tent difficult. One solution to this problem would be to color code each hose with a different color tape.

To monitor the air inside the tent, numerous air sampling stations were installed. These stations were connected to the existing building air sampling system and evaluated on a routine schedule established by the Health Physics Department. Other air samples were taken within the tent using continuous air monitors (CAMs) in each of the rooms which were set to alarm at a predetermined point.

2.6 SECTIONING OF GLOVE BOXES

Glove boxes which had all equipment removed and which were decontaminated to acceptable levels were transferred to a dismantling facility tent for sectioning. The standard glove box walls and tops were 0.109-in. (12 gauge) thick stainless steel, the floors were generally 0.140 in. (10 gauge) thick, the acrylic plastic windows were 3/8-inch thick, and, where installed, air locks were 1/4-inch stainless steel construction. Located inside the tent was all the necessary equipment required to completely section a glove box. All personnel wore protective clothing and were equipped with supplied breathing air. Once the glove box was in position inside the tent, sections were cut out of the top corners, approximately 4 in. x 4 in., to allow a starting point for the nibbler head to be inserted. Many glove box tops had two stainless steel reinforcing strips running the length of the box. These strips had to be cut in certain locations using reciprocating saws to allow for the nibbler to be used. Once started, the top of the glove box was cut, ending up with pieces approximately 3 ft x 3 ft. The top filter plenum was also removed at this time; because of its design, it was classified as an inaccessible area and would be foamed with a polyurethane high-density foam. Edges of all sectioned flat pieces were covered with pipe insulation to prevent a puncture to the .012-inch PVC plastic packaging bags. A manually operated hydraulic floor crane was used to lower the filter plenum and sectioned top of the box to the floor.

With the top of the glove box removed, the next step was to remove the glove box windows. It was decided to make the least number of cuts as possible through the window gasket material to avoid release of contamination. The sections of windows were cut to allow for a convenient-size package of no more than 5 feet square. Some of the glove box windows were approximately 8 feet in length; this required using a reciprocating saw to cut through the middle. Once the windows were removed, the only items left were the glove box ends and the bottom. All pipe and conduit sections protruding out of the glove box ends were removed, allowing for sectioning of the ends and the making of a flat package.

Once the ends of the glove box had been removed, the only portion remaining was the box floor. At times during the operation, problems were encountered in sectioning the floor. Because of the thickness of the floor, 0.140-inch (10 gauge), and the fixant that had been sprayed on the floor during the decontamination step, the nibbler would become clogged with the melted fixant because of the heat generated while running. In some cases, this buildup would cause damage to the die and punch of the nibbler. The heating effect was minimized by applying water from a hand-held spray bottle.

Tools used to section the glove boxes were A.E.G. KN-5 nibblers used for 10 and 12 gauge stainless steel, and reciprocating saws used in areas which were inaccessible to the nibbler. Numerous hand tools such as hammers, pry-bars, wrenches, and screwdrivers were used.

As previously discussed, during some of the glove box sectioning, window gaskets had to be cut through. This step caused some contamination to become dislodged from between the gasket and the window. To minimize this problem, RTV caulking was used around the areas to be cut. By doing this, the loose contamination was held to a minimum.

Another problem resulted from the chips generated by the nibblers. Extreme care had to be taken to keep the chips swept up, and personnel had to exercise caution when kneeling or sitting on the floor to avoid puncturing their protective clothing and their skin with the highly contaminated chips.

After glove box dismantling and sectioning was completed, the sections were wrapped once within the dismantling room, and again within the packaging room. The double-wrapped package was surveyed for external contamination and cleaned or wrapped again if necessary. Figures 2-9 and 2-10 show wrapped sections and the methods of handling and storage. Sheets of foam were utilized to protect edges and surfaces. During the wrapping operations, vacuum cleaners were utilized to evacuate the air from the packages prior to final heat sealing in order to provide a compact package.

2.7 HANDLING OF THE SINTERING FURNACE

The sintering furnace consisted of three large sections: preheat (49 in. x 32 in. x 23 in.), mainheat (82 in. x 53 in. x 55 in.), and cooling (67 in. x 10 in. x 7 in.). Glove boxes were attached to the preheat and cooling sections. For the dismantling of the furnace, all external insulating brick, covers, water cooling lines, and electrical supplies were removed. The cover gas lines were removed. Figure 2-11 shows the furnace complex after the insulation was removed. The glove box at the entry end is on the left, followed by the preheat zone and the high heat zone which is the large box-like affair.

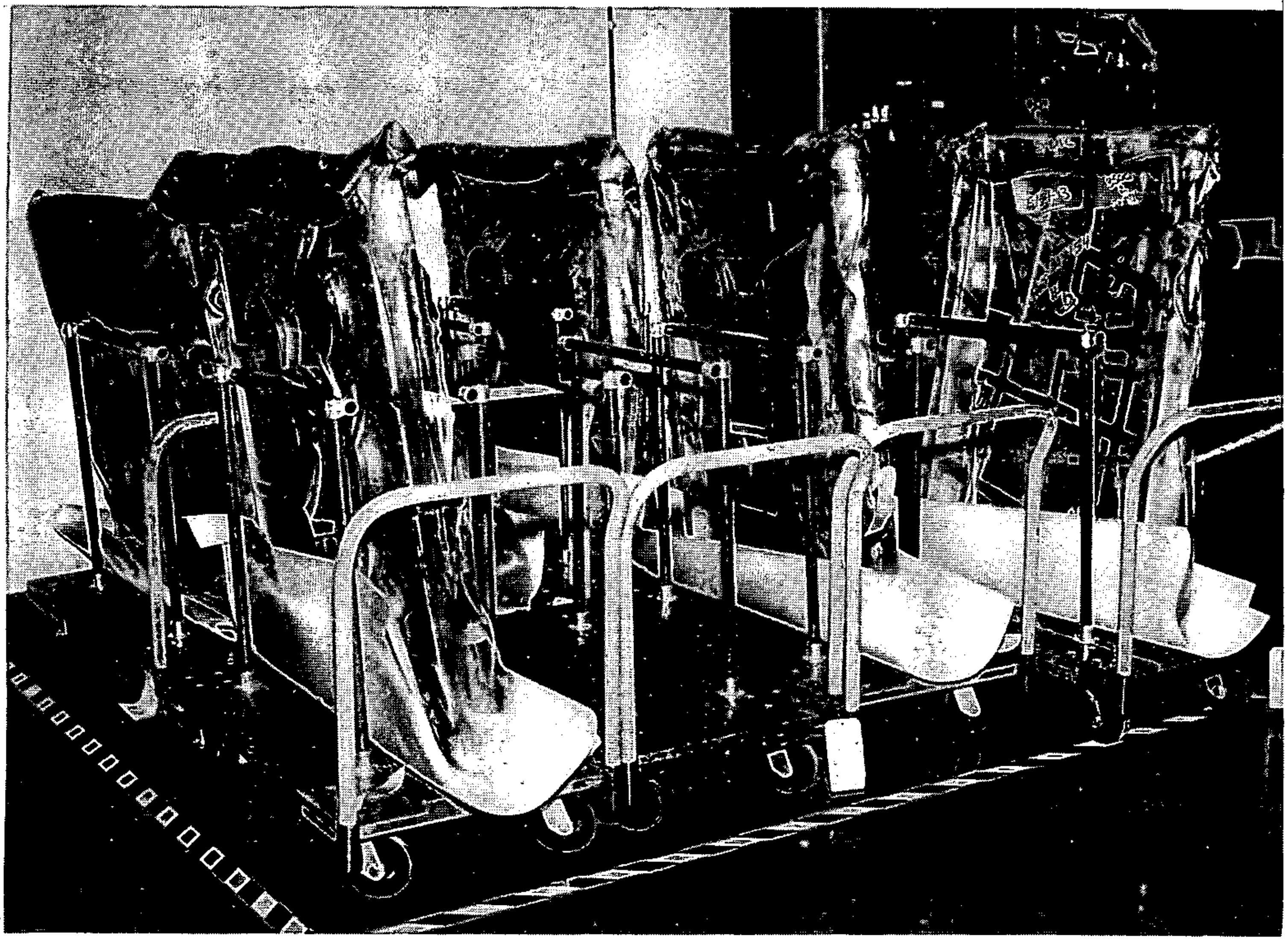

Figure 2-9. Plastic-Wrapped Cut Glove Box Sections on Handling Carts

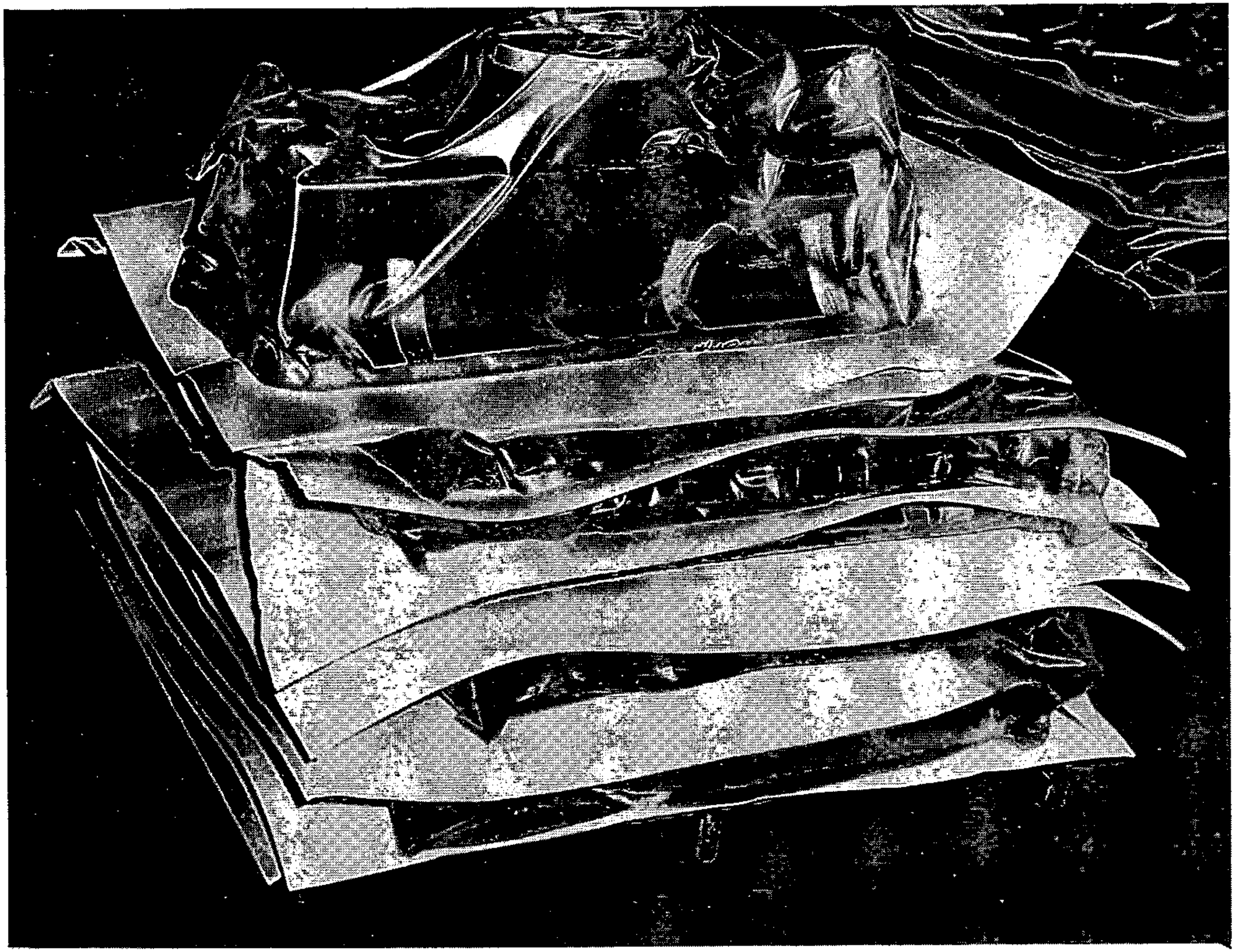

Figure 2-10. Plastic-Wrapped Cut Glove Box Sections Stored on Pallets

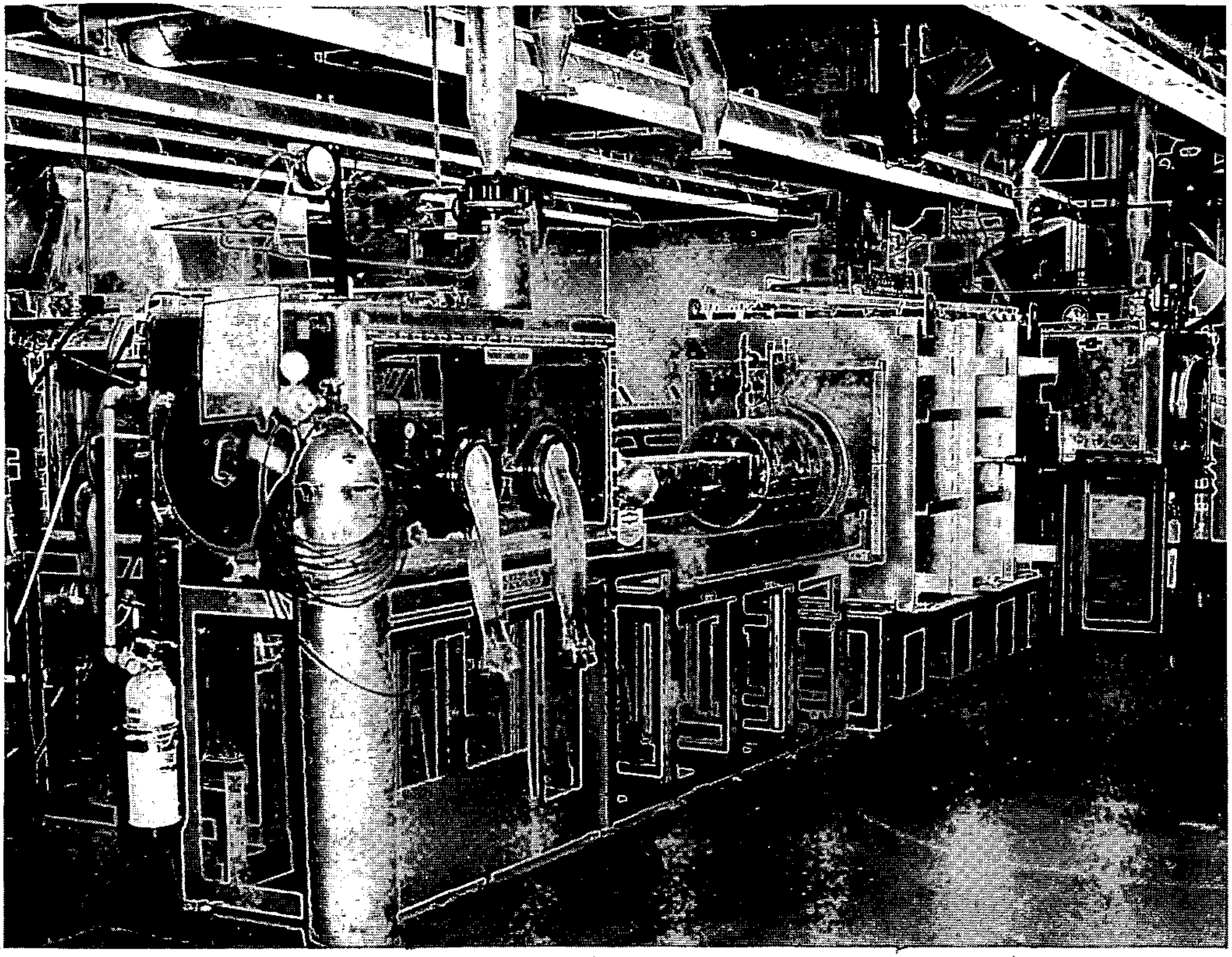

Figure 2-11. Ceramics Laboratory Pellet Sintering Furnace Complex

The hearth plates and sintering boat runners were removed and the accessible areas vacuumed to remove the dust. A coating of fixing agent was then sprayed from both ends to reduce airborne contamination during separation. The preheat and cooling sections were removed and taken to the sectioning tent where they were filled with foam to fix any contaminant. These pieces were shipped in a CSB.

The main heat section (Figure 2-12) was taken into the sectioning tent and the top covers were removed. The alumina bubble insulation was removed with a vacuum cleaner and the insulating brick removed. The bricks were packaged in 55-gallon drums. The steel furnace shell was cut into pieces for shipment in a CSB.

2.8 HANDLING OF PROCESS TANKS AND GLOVE BOXES

Various glove boxes in the laboratory contained process liquid holding tanks, some filled with borosilicate Raschig rings. The handling of these tanks for dismantling and disposal are described herein.

2.8.1 Glove Box No. 231-A

Glove box No. 231-A contained tank R-12 which was 18 inches in diameter by 120 inches long, of 3/16-inch-thick stainless steel. Because of the size and horizontal position of the tank inside the glove box, it was decided to cut the tank circumferentially in the middle to remove the Raschig rings from each half. With proper blocking to assure that the tank did not roll in either direction, a reciprocating saw was used to cut the tank in half; this was extremely difficult work and the majority of the time the technician had to lie on the floor. Once the cutting operation was completed, all sharp edges generated were ground with a high-speed hand grinder with a carbide burr. Using hooks and scoops, all Raschig rings were placed in one-gallon plastic bottles, bagged out, and transferred to the NDA area for analysis and subsequent disposal.

The two sections of the tank were scrubbed numerous times. Because of the high starting levels of contamination and inaccessible areas, it was not

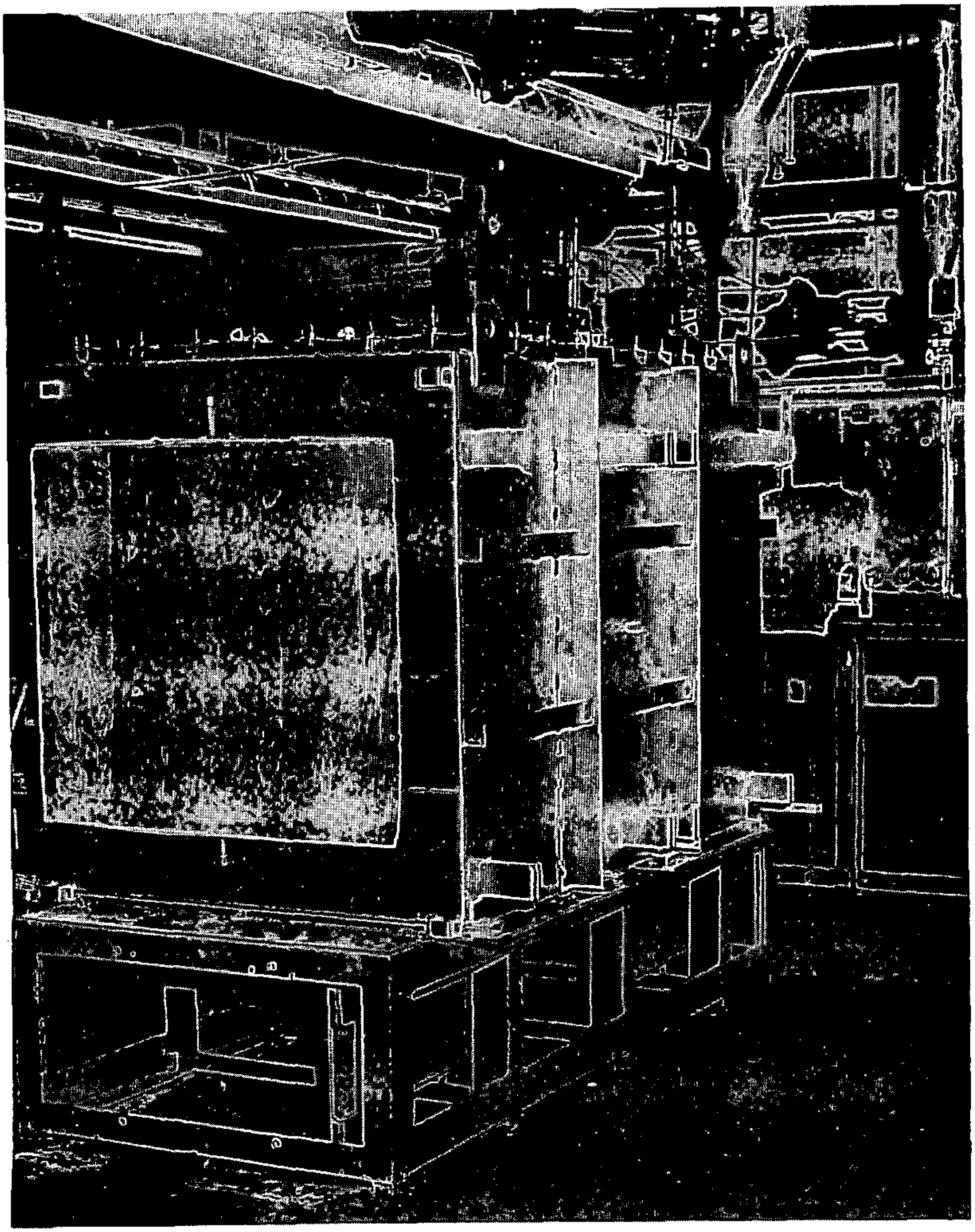

Figure 2-12. Ceramics Laboratory Sintering Furnace Main Heating Zone After Disconnecting

practicable to reduce the removable surface contamination to the required levels. The inside surfaces were then sprayed with the fixative used for glove boxes to contain the contamination during subsequent handling. After the fixative dried, all openings were covered and lifting hooks were attached by clamping to facilitate handling during removal from the glove box.

At this point, the decontamination of the glove box was performed following the established procedures described in Section 2.4.

The glove box with the tank inside was transferred to the dismantling facility, where the top of the box was removed to allow the crane to reach in and lift out the two sections of the tank. Both sections were then filled with polyurethane high-density foam, packaged in .012-inch PVC plastic sheet, and transferred to the NDA area.

2.8.2 Glove Box No. 241

Glove Box No. 241 contained four tanks filled with Raschig rings. The tanks were constructed of 3/16-inch stainless steel. Tanks R7 and R8 were 24 inches in diameter by 68 inches tall, tank R-14 was 30 inches in diameter by 44 inches tall, and tank R15 was 30 inches in diameter by 52 inches tall. All tanks were mounted vertically within the glove box on 12-inch (approximate) legs which were welded to the tanks and the glove box floor. Because there were no large openings in the tanks, it was decided to cut out approximately 12 in. x 12 in. sections of the tanks, which would allow removal of the Raschig rings. Cutting these sections proved difficult because the tanks were positioned approximately 8 inches from the windows. In addition, the glove box had windows located on the front only. Reciprocating saws were used to remove the sections of the tanks, then all cut edges were ground with a high-speed hand-operated grinder. The Raschig rings were removed with hooks and scoops to avoid a puncture to the glove box glove. Once all the accessible rings were removed, additional sections of the tank were cut away; these steps were followed until all the rings were removed. A tank with a section cut is shown in Figure 2-13; the Raschig rings can be seen just above the lower left glove port.

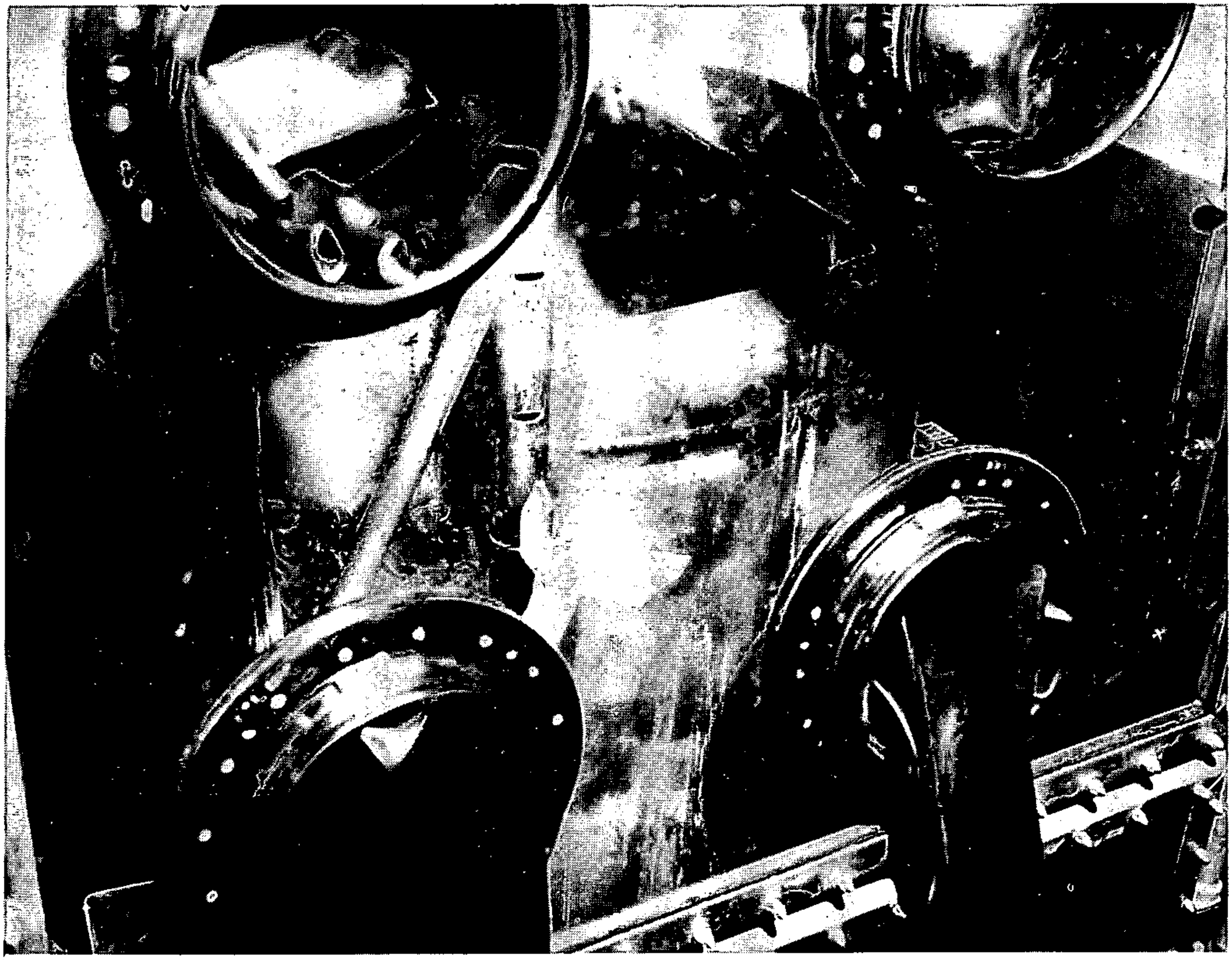

Figure 2-13. Liquid Storage Tank R-15, Located in Glove Box 241, with Section Removed Exposing Raschig Rings

The Raschig rings were placed in one-gallon plastic bottles, bagged out, and transferred to the NDA area. Edges on the sections that were removed from the tanks were ground to prevent punctures to the gloves. The sections were then wrapped in a foam packing, bagged out, and sent to the NDA area.

Once all the equipment was removed from Glove Box No. 241, the decontamination of the box was started. Problems were encountered with the decontamination of this box because of its size, 150 inches long by 52 inches wide by 117 inches high, and because of its windows being located on only one side. Sponge mops on 5-foot handles and squirt bottles with decontamination solution were used to reach otherwise inaccessible areas. Because of its large size, once the glove box was decontaminated to acceptable levels, a dismantling facility was constructed around it and the glove box was sectioned in place.

2.8.3 Glove Box No. 242

Glove Box No. 242 contained three process tanks: R3 was 5 inches in diameter by 93 inches tall, R4 was 5 inches in diameter by 125 inches tall, and R11 was 5 inches in diameter by 78 inches tall; all were constructed of 1/4-inch-thick stainless steel. These tanks did not contain Raschig rings. All three tanks were mounted on 12-inch (approximate) legs which were welded to the tanks and the floor of the glove box. Scaffolds were used outside the glove boxes to allow the technician to reach the top glove port on the front glove box window. Ropes were secured inside the glove box to a section of a tank approximately 24 inches from the top; these ropes were attached to a penetration on the inside roof of the glove box. Once secured, the tank was cut approximately 24 inches from the top using reciprocating saws, and this section was then lowered to the glove box floor. This operation was repeated for each 24-inch section. All cut edges were ground with a high-speed hand grinder with a carbide burr to avoid punctures to the glove box gloves. The cut pieces were then wrapped in foam packing, bagged out, and transferred to the NDA area.

Glove Box No. 243 was 68 inches long by 28 inches wide by 149 inches high and had windows located on one side. Sponge mops with 5-foot handles were used to reach inaccessible areas, and squirt bottles with decontamination solution were used for the inside areas. Due to its large size, once the decontamination was completed to acceptable levels, a sectioning tent was constructed around the glove box and it was sectioned in place.

2.8.4 Glove Box No. 233

Two tanks were located in Glove Box No. 233; each tank was 5 inches in diameter by 45 inches long, constructed of 1/4-inch-thick stainless steel. These tanks were located in the center of the glove box floor and extended below the glove box floor by approximately 40 inches. Because of the size and position of the tanks within the glove box, a 3/4-inch wooden cover was placed over the top and was attached with RTV sealant; this area was classified as inaccessible and would be filled with a polyurethane high-density foam once it was taken to the sectioning area. The inside of the glove box was then decontaminated to the acceptable levels and transferred to the sectioning area.

2.9 HANDLING OF CONTAMINATED DUCT AND FILTER CAISSONS

2.9.1 System Description

Glove boxes and fume hoods were exhausted into a system of ducts, filters, and blowers which provided a constant draw. HEPA absolute filters were located at glove boxes where they exhausted into the duct, and in the duct near the fume hood exhausts. The duct serving the laboratory equipment on the first floor fed into the second floor penthouse where the final dual series HEPA filters and exhaust blowers were located.

Duct materials included plastic, aluminum, and stainless steel. Most joints were welded except for glove box and filter connections which were flanged. Dimensions of the duct ranged from 6 inches in diameter to 18 inches by 36 inches cross section. A typical array of duct is shown in Figure 2-14. Filter caissons in the Penthouse ranged in size from 24 inches by 34 inches by 30 inches containing one filter, to 128 Inches by 34 inches by 50 inches containing four filters.

Figure 2-14. Typical Array of Glove Box Air-Handling Duct with Smaller Sections Removed

Although filters were located at the exits of all glove boxes and hoods, contamination existed in the duct extending beyond these filters into the penthouse filter caissons. This contamination resulted from material passing through the filters, and material injected into the system while the filters were being changed.

The procedure finally evolved for removal of duct and caisson is PFDL Operating Procedure No. PFDL-OP-D-0861 (see Appendix B).

2.9.2 Removal of Duct

Thin plastic sheet (0.12 inch) enclosures were erected around each portion of duct where cuts were to be made. The purpose of these enclosures was to contain any chips or other debris which might result from the cutting. They were not designed to provide a hermetic containment since the air influx into the cut duct would provide adequate control of airborne contamination. Cutting was started at the system's extremes, and worked back toward the exhaust blower in order to always take advantage of the system's draw to provide an advantageous air flow. The duct was supported where needed prior to cutting so that sections would not fall. Personnel wore double sets of protective clothing and filtered air full-face masks; continuous alarming air monitors were placed in the vicinity of the cutting operation.

Cutting was accomplished with power shears and nibblers, reciprocating power saws, and heated wires for some of the plastic duct. The best shears for this work were the rotary type which cut a narrow ribbon; the scissor-type shears were very difficult to use on the curved surfaces. An electrically heated resistance wire apparatus was assembled for cutting plastic duct. It consisted of resistance wire powered by a variable transformer; the resistance wire was mounted on a wooden frame. The use of the hot wire eliminated cutting chips and vibration, and thus reduced the possibility for the spread of contamination. The hot wire cutter performed satisfactorily; the cut had a tendency to reweld behind the hot wire, but this was solved by using a larger wire and flexing the duct material in the vicinity of the cut. As the cutting operations progressed, however, it was found that saw cutting of the plastic did not present a contamination problem, since all debris was sucked into the duct, and was much quicker than cutting with the hot wire.

As each cut was completed through a section of duct, the exposed hole in the static cut section was covered by a prepared piece of plywood and taped in place; the same was done to the active remaining duct. The active section required caution in placing the plywood cover since there was a large negative draw on the duct which resulted in considerable force on the cover which, if not properly placed, could have resulted in hand and finger injuries. The duct sections were then sent to a sectioning facility for further size reduction and packaging.

2.9.3 Filter Caissons

The final HEPA filter caissons each contained from one to four HEPA filters, 24 inches square by 12 inches thick. Four-filter caissons are shown in Figure 2-15. The HEPA filters were in bag assemblies so that they could be removed and new filters bagged on (or empty bag stubs bagged on) without exposure of the filter's or caisson's contaminated internals to the atmosphere.

The decision was made to allow the used contaminated filters to remain in place, for removal later when the caissons were sectioned. It was felt that disturbing the contaminated filters might dislodge contamination which could further contaminate the cleaner final filter caisson. It was also decided to turn off and disconnect the exhaust blower before separating the first filter caisson from the final filter caisson for the same reason, to minimize the carryover of any dislodged contamination. This was done to eliminate the risk of exhausting potentially contaminated air to the environment through only a single-stage HEPA filter.

Removal of the caissons went smoothly. The exhaust blower and duct were disconnected from the final caisson and the opening was covered. An enclosure was erected around the connection between the first and the final filter caissons which were located one above the other. The top caisson was lifted after the connection was unbolted, the openings were surveyed by Health

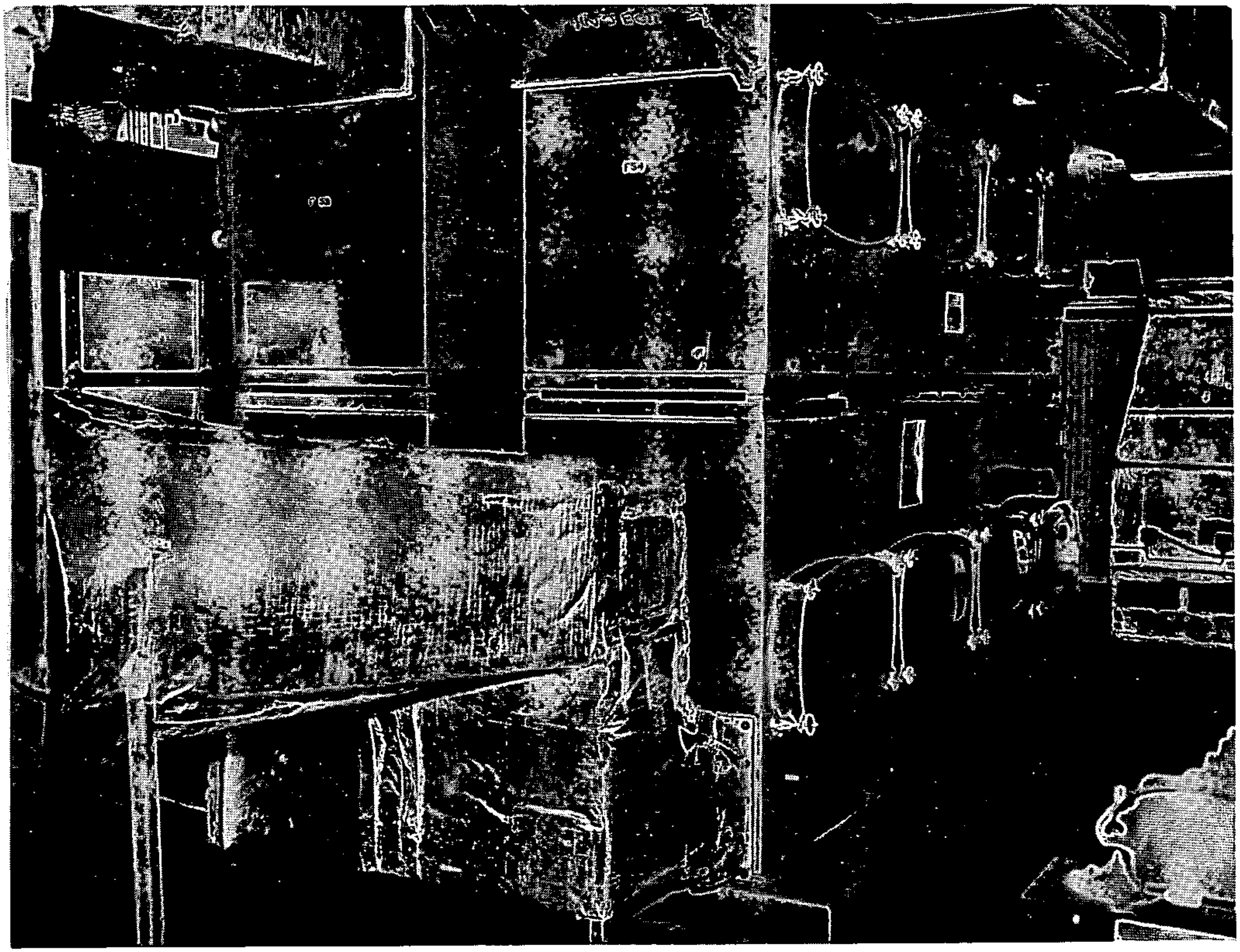

Figure 2-15. Typical Glove Box and Room Air-Handling Filter Caissons Located in the Penthouse

Physics personnel, and the openings were covered. The bottom caisson was moved out of place, and the top then lowered. The caissons were moved to a sectioning and dismantling facility for disassembly and cutting.

2.10 SUSPECT WASTE PIPES AND TANKS

2.10.1 Description of System

The suspect liquid waste system for the Plutonium Laboratory consisted of three 1,000-gallon stainless steel tanks located below ground outside the building, and connected by stainless steel and plastic piping to various sinks, showers, dehumidifiers, and emergency sprays in the ventilation ducts. An illustration of the partially uncovered tanks with some of the plumbing exposed can be seen in Figure 2-16. The tanks after removal from the ground are shown in Figure 2-17.

Suspect waste from these areas was collected in these tanks, pump mixed, analyzed, and released to the sanitary sewer system if the liquid was within the applicable release limits.

2.10.2 Dismantling Procedure

At the conclusion of all decontaminating and dismantling operations within the laboratory that might generate liquid suspect waste, all suspect waste lines within the PFDL were disconnected, cut into small sections, and packaged for shipment to Hanford for burial.

The three 1,000-gallon stainless steel tanks were emptied and the interiors of the tanks were scrubbed with a high-pressure water system containing a low sudsing detergent, then rinsed and scrubbed again with the high-pressure water system containing NUTEC. These operations were repeated four times.

Health Physics technicians with proper protective gear were sent inside the tanks to measure radiation levels in the tanks and on the wall surfaces. Data showed areas of fixed contamination of up to 250 dpm/100 cm^3 and smearable contamination levels of up to 400 dpm/100 cm^3 randomly throughout the three

Figure 2-16. Partially Exposed Suspect Liquid Waste Holding Tanks Located Outside PFDL Building 8

Figure 2-17. Suspect Liquid Waste Holding Tanks After Removal from the Ground

tanks. The "hot spots" were decontaminated by hand scrubbing with NUTEC to less than 20 dpm/100 cm^3 removable and less than 100 dpm/100 cm^3 average total surface contamination.

The tanks were removed from the ground, cut into several pieces, and sent to a scrap yard for remelt.

2.11 STRUCTURE INTERIOR SURFACES

The material access area of the laboratory was a two-story structure*. The main laboratory was located on the ground floor and consisted of approximately 16,000 square feet used for activities related to the fabrication of uranium-plutonium fuels. The second story, or penthouse, provided 6,400 square feet of floor space for facility support systems.

2.11.1 Main Laboratory

2.11.1.1 Walls and Ceiling -- The walls and portions of the ceiling in the main laboratory had been repainted during the active life of the laboratory. To facilitate the final survey of the walls and ceiling, all paint was stripped** to expose the original plaster surface. The stripping process consisted of brushing or rolling on paint stripper, letting it set for several minutes, and then scraping the loose paint from the plaster. The damp pieces of stripped paint were collected, allowed to air dry on large sheets of plastic, and loaded into drums for ultimate burial. Approximately 25,000 square feet of painted wall and ceiling surfaces were stripped. Precautions taken were those recommended by the paint stripper's manufacturer, i.e., use in a well-ventilated room with proper eye, face, and hand protection.

2.11.1.2 Floor -- The floor in the main laboratory was painted with a polyurethane top coating during construction of the laboratory. When the floor was initially repainted, a layer of red paint was applied over the original polyurethane top coating. An initial coating of blue paint was

*See Section 1.2.2 for more specific details.

**KS-3 "KLEAN-STRIP" paint remover, W. M. Barr, Inc., Memphis, Tenn.

put over the red layer of paint. In subsequent years, various portions of the main laboratory floor were repainted with various shades of blue and gray paint.

During decommissioning, the floor was stripped to remove all paint through the red coat, which exposed the original paint which was applied before the laboratory was committed to uranium and/or plutonium processing. In various areas of the main laboratory, slight contamination was found after the paint had been removed. The concrete in these areas was scarified* to remove the contamination. In the area that formed the original Chemical Analysis Laboratory, the entire floor was scarified after the paint was stripped since during plant operations a minor liquid spill had occurred which contaminated the floor. To assure that all residual contamination from that spill was removed, the entire expansion joint in that area was also cut out of the floor.

2.11.2 Penthouse

The floor, walls, and ceiling in the penthouse had never been repainted after construction. Therefore, no decontamination activities were performed on these surfaces prior to the health physics survey.

2.12 NONDESTRUCTIVE ASSAY

The nondestructive assay (NDA) of all waste generated in the decontamination and decommissioning (D&D) effort, from tools through whole glove boxes, was accomplished utilizing gamma spectrometry to provide semiquantitative analysis for plutonium and uranium-235 content. In addition, other measurement equipment utilizing gross neutron counting and beta/gamma detection was employed to provide a qualitative survey on large items such as motors, pellet presses, furnaces, etc. to assure that they did not contain significant quantities of SNM (plutonium and uranium-235) in hidden areas.

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*A Model V-5 scabbler manufactured by MacDonald Air Tool Corporation, Hackensach, NJ, was used to scarify the floor.

Since an estimate of the plutonium and uranium-235 content of each item of contaminated waste was required for the D&D effort, two gamma ray spectrometry systems were utilized to provide this information:

1) A fixed system was permanently located in a low-activity-level room and was used to determine the SNM content of individual waste packages contained within 55-gallon drums and, in addition, 55-gallon drums containing presurveyed high and low density waste. The assay system consisted of a Princeton Gamma Tech horizontally mounted intrinsic coaxial germanium detector, power bin modular electronics, and a Tracor-Northern multichannel analyzer for data display and readout as described in Table 2-4. The system was calibrated for plutonium and uranium-235 via the 186 key photopeak for uranium-235 and 414 key photopeak for plutonium-239 (PFDL Analytical Procedure No. PFDL-AL-0023). The calibration standards consisted of a series of one-gallon plastic bottles containing a low density matrix and 0.1 to 15.0 grams each of uranium-235 and plutonium-239 (PFDL Analytical Procedure No. PFDL-AL-0051). Each standard was placed a fixed distance from the detector, rotated by a turntable, and counted for ten minutes. The data from the standards were analyzed via a Texas Instruments SR-60 programmable calculator. The waste packages were then assayed in a manner similar to the standards. The assay accuracy was estimated to be better than ±25 percent when the unknown closely resembled the standard.

2) The portable system was used to assay items which were too large to fit in 55-gallon drums, such as HEPA filters, gas purifiers, whole glove boxes, etc. (PFDL Analytical Laboratory Procedure No. PFDL-AL-D-0057). This assay system consisted of an Ortec horizontally mounted intrinsic coaxial germanium detector in a 7-liter dewar, power bin modular electronics, and a Tracor-Northern 1710 multichannel analyzer for data display and readout. The detector was stationed on a hydraulic lift, which could raise or lower, with wheels for movement within the laboratory; the remainder of the electronic system was stationed on a heavy-duty cart.

TABLE 2-4

EQUIPMENT USED ON THE TWO PASSIVE GAMMA SYSTEMS FOR NON-DESTRUCTIVE WASTE ASSAY

Location	Detector	Multichannel Analyzer	Electronics	Printer
Permanent, Counting Room in Bldg. 8	Princeton Gamma-Tech, Model IGC-11 Intrinsic Germanium • Detector Geometry, Coaxial • Cryostat Configuration, Side Looking • Efficiency, 11.3% • Resolution, 1.93 kev FWHM at 1.332 MeV ^{60}Co • Peak Shape, 1.87 FWTM/FWHM • Peak/Compton, 36.9/1 • Dewar, 30 Liter	Tracor-Northern, NS-700	• NIM Bin, Tennelec TB-3/TC-911 • Power Supply, Tennelec TC-940 • Preamp, Princeton Gamma Tech RG-11AC • Amplifier, Canberra 2011	Western Union Teletype, 33 ASR
Portable, Weld Lab in Bldg. 8	EG&G Ortec, Model 1512-10180G High Purity Germanium Coax • Detector Geometry, Coaxial • Cryostat Configuration, Bucket Side Looking • Efficiency, 11.5% • Resolution, 1.75 kev FWHM at 1.332 MeV ^{60}Co • Peak Shape, 1.85 FWTM/FWHM • Peak/Compton, 46:1 • Dewar, 7 Liter Bucket	Tracor-Northern, TN-1710	• NIM Bin, Ortec 401M/402M • Power Supply, Ortec 459 • Preamp, Ortec 120-5 • Amplifier, Ortec 572	Centronics, 730-3

The application of this system consisted of calibration with uranium-235/plutonium-239 vial/flat standards (PFDL Analytical Laboratory Procedure No. PFDL-AL-0051), transmission measurements, assay of the contaminated item, and analysis of the data. Because of the diverse nature and large size of the items assayed, the measurement accuracy, under optimum conditions, was estimated to be $\pm$100 percent. Since these items generally contained fractions of a gram of plutonium and uranium-235, the large measurement uncertainty was not a major problem.

The data summarized in Table 2-5 gives a comparison of gamma assay versus chemical assay. Several things regarding the table should be pointed out:

- o The gallon standards and the vial/flat standards are listed separately since they represent different geometries.

- o The chemical assay data were assumed to be true for purposes of evaluating the gamma assay results.

- o The gamma results represented an idealized case since the "unknowns" had a matrix, chemical form, isotopic distribution, and SNM distribution which was essentially identical to the gamma standards used to calibrate the two NDA systems.

Based on the analysis of D&D waste for plutonium and uranium-235, PFDL experience has shown that:

1) Destructive chemical assay for plutonium and uranium (uranium-235) can easily achieve accuracies within 0.5 percent. However, to achieve these accuracies, the material to be analyzed must be uniform, well characterized, and completely dissolved. Unfortunately, D&D waste rarely fits these requirements; therefore, chemical assay was not a practical assay method.

TABLE 2-5

COMPARISON OF GAMMA ASSAY VERSUS CHEMICAL ASSAY
OF ANALYTICAL STANDARDS

Gallon Standards				Vial/Flat Standards			
^{235}U (Gram)		Pu (Gram)		^{235}U (Gram)		Pu (Gram)	
Gamma Assay	Chemical Assay	Gamma Assay	Chemical Assay	Gamma Assay	Chemical Assay	Gamma Assay	Chemical Assay
5.60	5.00	5.24	5.00	1.07	1.00	1.04	1.00
5.52	5.00	4.90	5.00	1.01	1.00	1.07	1.00
5.63	5.00	5.17	5.00	1.00	1.00	1.09	1.00
5.65	5.00	5.10	5.00	1.01	1.00	1.06	1.00
5.51	5.00	5.12	5.00	1.04	1.00	0.95	1.00
5.59	5.00	4.95	5.00	0.96	1.00	0.94	1.00
5.52	5.00	4.92	5.00	1.03	1.00	1.05	1.00
5.63	5.00	5.14	5.00	0.99	1.00	1.00	1.00
5.44	5.00	5.18	5.00	1.01	1.00	0.98	1.00
5.69	5.00	4.96	5.00	1.01	1.00	0.93	1.00
5.55	5.00	5.13	5.00	1.03	1.00	1.04	1.00
5.45	5.00	4.97	5.00	1.02	1.00	1.03	1.00
5.70	5.00	5.12	5.00	1.01	1.00	1.06	1.00
5.57	5.00	4.97	5.00	1.04	1.00	0.98	1.00
5.66	5.00	4.91	5.00	1.01	1.00	1.05	1.00
5.30	5.00	5.15	5.00	0.96	1.00	1.02	1.00
5.38	5.00	5.19	5.00	1.01	1.00	1.11	1.00
5.41	5.00	4.94	5.00	1.02	1.00	1.03	1.00
5.42	5.00	5.16	5.00	1.01	1.00	1.07	1.00
5.54	5.00	5.08	5.00	1.00	1.00	0.91	1.00
5.49	5.00	5.12	5.00	1.00	1.00	1.01	1.00
5.56	5.00	5.08	5.00	1.00	1.00	1.02	1.00
5.55	5.00	5.05	5.00	1.00	1.00	1.05	1.00
5.59	5.00	4.90	5.00	1.00	1.00	1.18	1.00
5.59	5.00	5.00	5.00	1.01	1.00	1.08	1.00
5.46	5.00	5.11	5.00	1.03	1.00	1.00	1.00
5.67	5.00	4.78	5.00	1.08	1.00	1.04	1.00
5.68	5.00	5.11	5.00	1.08	1.00	0.99	1.00
5.61	5.00	5.01	5.00	1.01	1.00	0.98	1.00
5.31	5.00	5.01	5.00	0.98	1.00	1.10	1.00
5.49	5.00	5.09	5.00	1.03	1.00	1.17	1.00
5.36	5.00	5.02	5.00	1.02	1.00	1.19	1.00
$\bar{X}$ = 5.535 Gram		$\bar{X}$ = 5.049 Gram		$\bar{X}$ = 1.015 Gram		$\bar{X}$ = 1.051 Gram	
S = 0.110 Gram		S = 0.107 Gram		S = 0.026 Gram		S = 0.074 Gram	

2) Accuracies within 10 percent were readily achievable with gamma assay when the standards and unknowns had similar:

   - o Geometries
   - o Matricies
   - o Chemical Form of SNM
   - o Distribution of SNM
   - o Isotopic Content.

   Since our D&D waste was not generally representative of the NDA standards from a geometry and matrix standpoint, assay accuracies of 10 percent were not routinely achievable. (NOTE: An important consideration was that greater than 97 percent of the D&D waste which was gamma assayed contained significantly less than one gram SNM (plutonium plus uranium-235) per item.)

3) The gamma assay systems employed represented a reasonable compromise in cost, assay capability, accuracy, and system stability.

Passive gamma spectroscopy is a well-established technique for nondestrictive assay; it provided the basis for the analysis of all D&D waste. However, the potential user must decide whether the systems used at PFDL would be useful based on such considerations as:

- o Type of waste
- o Elements to be assayed
- o Availability of calibration standards
- o Desired detection levels
- o Cost

One might consider supplementing passive gamma spectroscopy with alpha counting and/or neutron assay, and in addition, consider the use of active NDA techniques.

Benefits from the approach used to assay D&D waste at PFDL were:

1) The passive gamma systems have proven useful for semiquantitative determination of uranium-235 and plutonium in a wide variety of contaminated waste.

2) The systems have been very reliable over the past several years with minimal downtime (<1 percent).

3) The two systems (see Table 2-4 for details) were purchased at moderate cost (<$60,000).

4) The systems are modern/versatile such that they would be useful in other NDA work upon completion of the D&D program at PFDL.

In summary, the systems utilized on D&D waste permitted assay from a fraction of a gram SNM and upwards. The addition of some of the new systems described above might be useful to extend assay capability to the determination of SNM in liquids and also have the sensitivity to survey solids at the $\leq$10 nCi/gram level.

2.13 WASTE MANAGEMENT

The quantities of plutonium associated with the transuranic wastes require shipment in overpacks. In addition, per 10 CFR 71.42, plutonium in excess of 20 curies must be in the form of metal, metal alloy, or reactor fuel elements unless specifically exempted by the NRC.

For the ARD D&D, these conditions were satisfied with the Model 6272 overpack with the steel bin both as a burial container and as a transport container for the drums. Whole glove boxes, after decontaminating and fixing the inside surfaces, were foamed in place in fiberglass-reinforced polyester-coated plywood boxes (FRPs) which were approved for shipment in the Model 6400 overpack. These packages were not particularly suitable for the NFD D&D for the following reasons:

1) The steel bins had to be placed inside corrugated steel boxes at Rockwell Hanford Operations (RHO) for the burial support, requiring the purchase of two steel boxes. This also resulted in increased wasted burial volume.

2) The higher curie per gram NFD material made the distribution of 20 curies over eight drums more difficult.

3) The whole glove box package allowed only one package per Model 6400 shipment.

To overcome these difficulties, the use of the N-55 drum overpack was initiated, allowing up to 20 curies in a single drum.

The RHO corrugated steel box (CSB) was slightly modified such that two of them fit into a Model 6400 overpack. These containers, as well as the FRPs, were approved for shipment in the Model 6400, provided certain packaging conditions were satisfied. The waste items could be cut to size to fit in these boxes, allowing better payload. The loading of these packages was approved by RHO.

Therefore, for the NFD D&D effort, the transuranic (TRU) waste was shipped in one of three burial-site-approved packages. These packages were:

1) Galvanized steel drums
2) Epoxy coated, corrugated steel boxes
3) Fiberglass reinforced polyester coated plywood boxes.

The drums were shipped in Model N-55 overpacks and the boxes were shipped in Model 6400 overpacks. The nontransuranic (Non-TRU) waste was shipped in steel drums.

Prior to loading any of these packages, laboratory items were first disassembled and then segregated into specific categories which were derived from burial site and transportation criteria. Each item was then prepared for packaging according to the requirements of its classification.

The specific classification and packaging procedures for the use of each of the approved packages, including some additional containers and overpacks which were approved but not used, are described in this section.

2.13.1 Waste Classification and Definition

Each item in the laboratory was categorized as clean, non-TRU/low specific activity (LSA), or TRU depending upon the level of contamination; some items were decontaminated in order to change their category. The clean items required no additional segregation or packaging for disposal. The non-TRU/LSA items required no additional segregation, but required specific packaging for disposal. The TRU items required both additional segregation and specific packaging for disposal.

Retrievable storage at the burial site required the combustible waste items to be segregated from the noncombustible items, not including the packaging and padding used for the noncombustible items. Waste items with both combustible and noncombustible components which were not readily separable were treated as combustible waste. This requirement applied to all TRU waste.

Use of the Model 6400 overpack required that hard and soft wastes be segregated. Hard waste items were defined as those items rigid enough to be forced through the plastic bagging materials unless suitably blunted or padded. Soft waste items were defined as items that can be compressed to conform to the package without padding. Each type of waste required specific treatment and packaging for shipment. Waste items with both hard and soft components which were not readily separable were treated as hard waste.

The special case items which included liquids (aqueous and organic) and poisons (mercury) were set aside for special handling procedures.

2.13.2 Packaging

The following paragraphs describe the loading of the drums and boxes used for the transuranic waste. Figures 2-18a through 2-18h are a series of flow sheets showing the waste segregation and packaging processes.

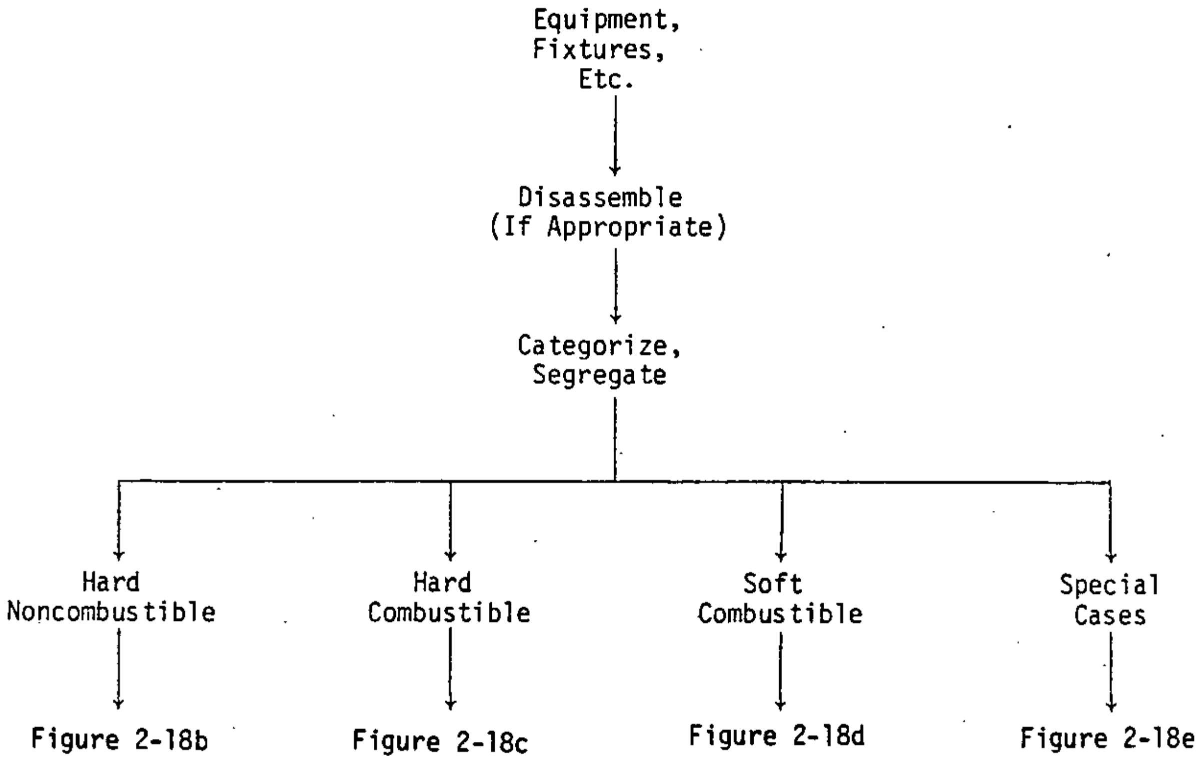


Figure 2-18a. Waste Segregation

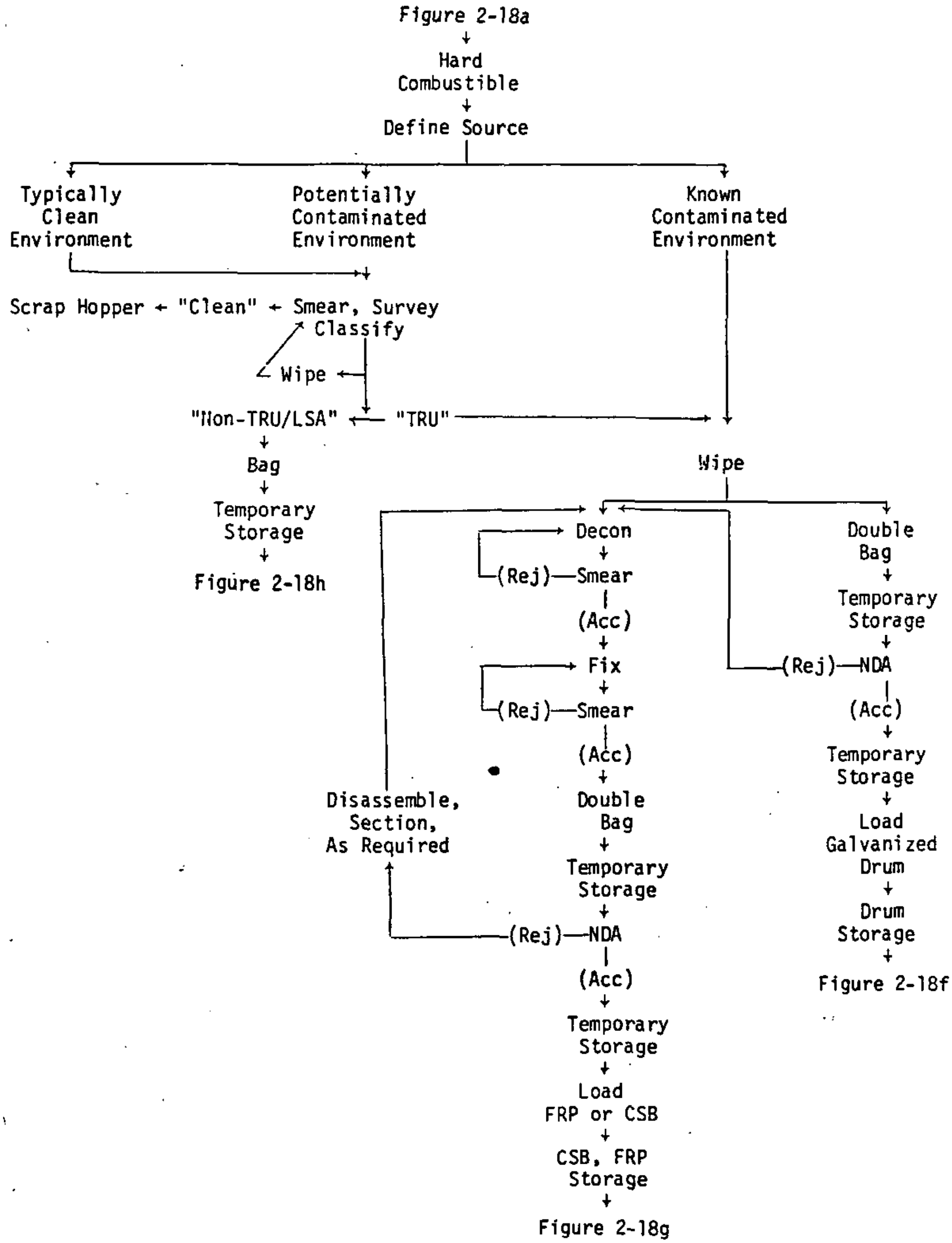


Figure 2-18b. Packaging -- Hard Combustible Waste

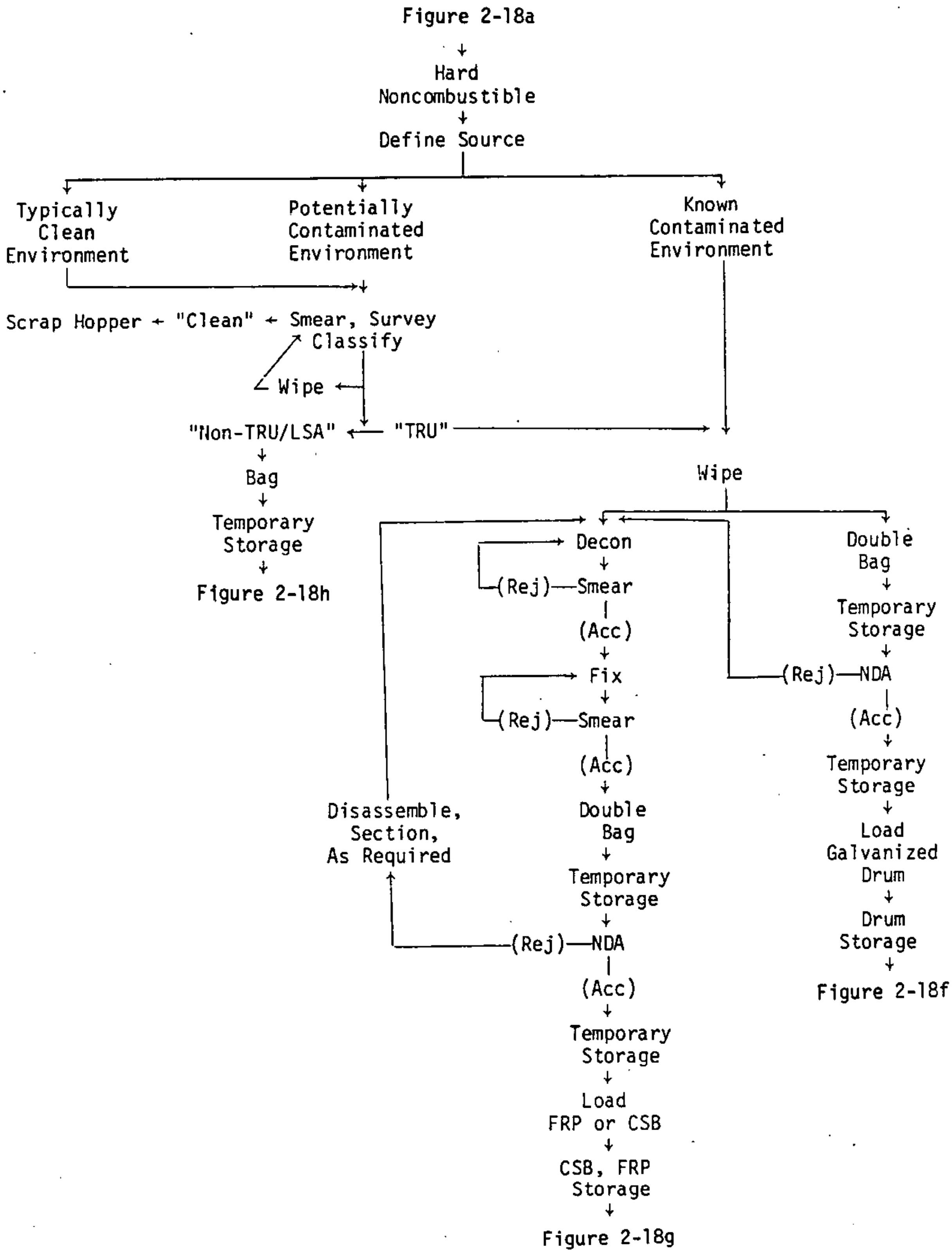


Figure 2-18c. Packaging -- Hard Noncombustible Waste

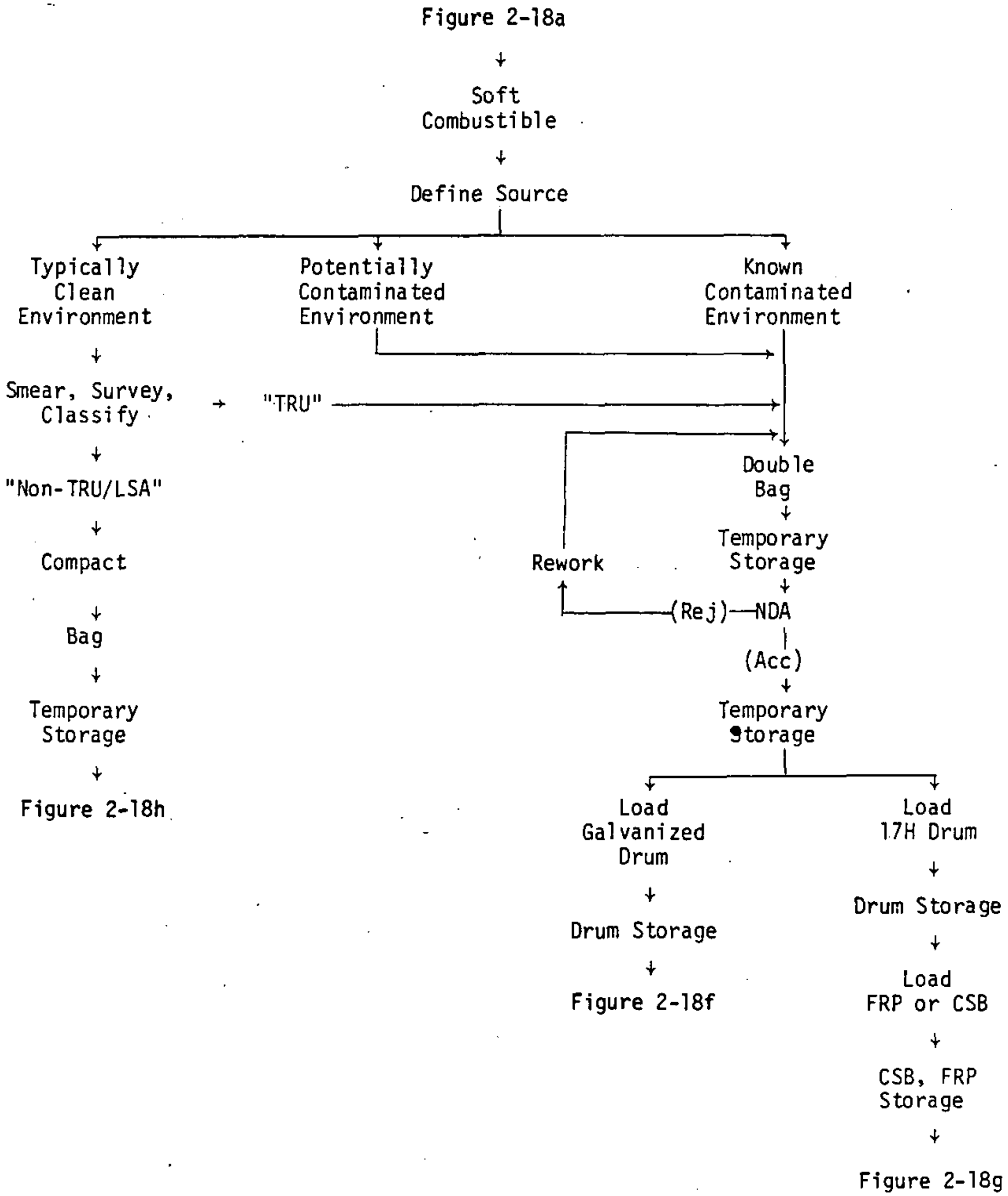


Figure 2-18d. Packaging -- Soft Combustible Waste

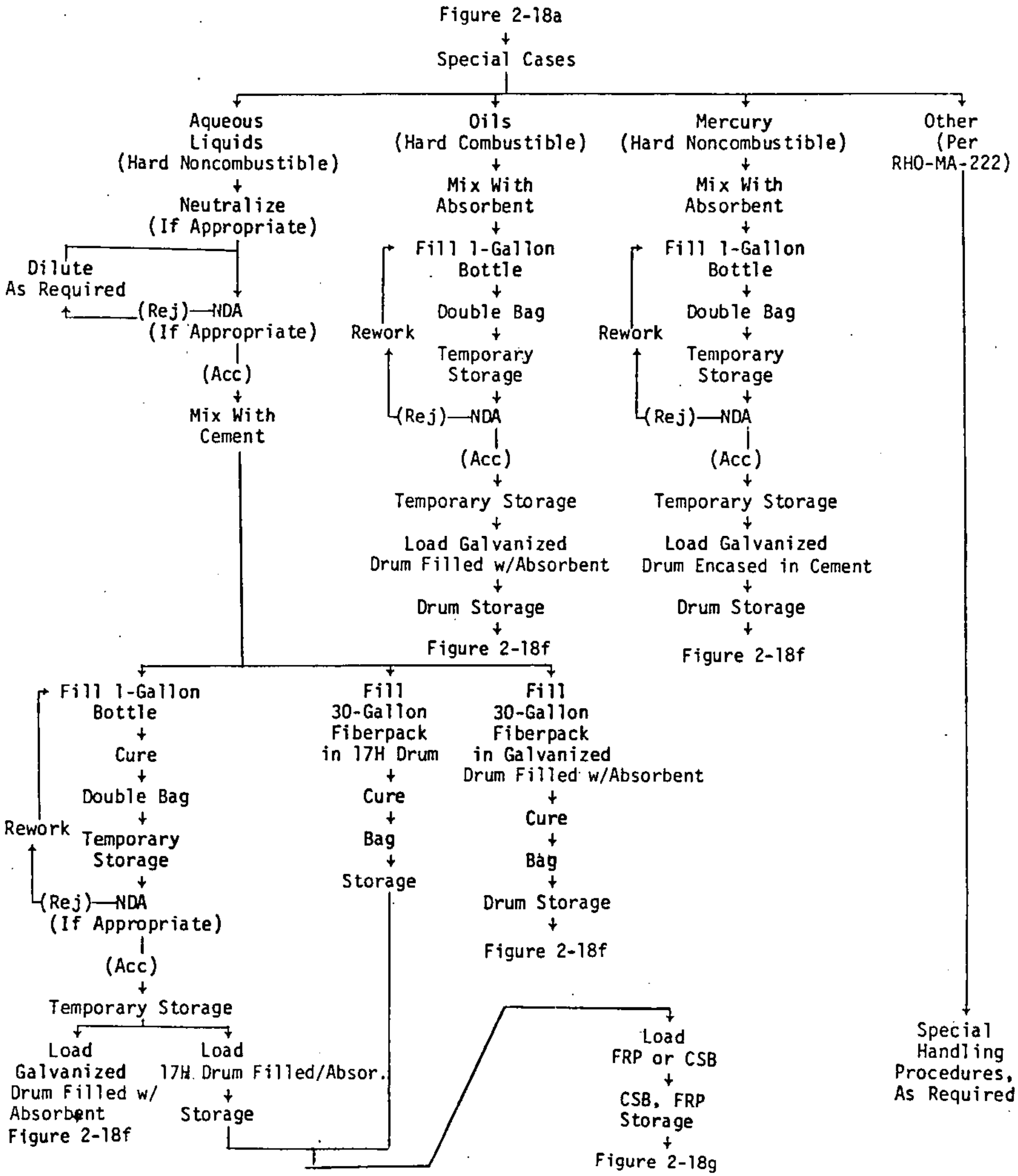


Figure 2-18e. Packaging -- Special Cases of Waste

Figure 2-18b | Figure 2-18c | Figure 2-19d | Figure 2-18e

↓

Galvanized Drum Storage

↓	↓
Load 1 Drum/Model N-55 Overpack	Load Up to 8 Drums/M-III Bin
↓	↓
Load Trailer (Up to 76 Overpacks)	Load Bins Into Trailer-Mounted Model 6272 Overpack (Up to 6 Per Truck)
↓	↓
Ship	Ship

Figure 2-18f. TRU Waste Packaging for Shipment in Galvanized Drums

Figure 2-18b | Figure 2-18c | Figure 2-18d | Figure 2-18e

↓

CSB or FRP Storage

↓

Load Up to
2 CSBs or FRPs in
Trailer-Mounted
Model 6400 Overpack

↓

Ship

Figure 2-18g. TRU Waste Packaging for Shipment in CSB or FRP Containers

Figure 2-18b   Figure 2-18c   Figure 2-18d

↓

Load Non-TRU/LSA Containers
(No Segregation Restrictions)

↓

Storage

↓

Load Trailer

↓

Ship

Figure 2-18h. Non-TRU and LSA Waste Packaging for Shipment

I) Galvanized Drums

A) Normal Waste

Segregated waste items were blunted or padded as required and double bagged. These double-bagged packages were placed in plastic-lined drums and polyurethane foam was applied as required to brace the packages. The drum liner and the drum were sealed. The drum was shipped in a Model N-55 overpack (Figures 2-19 and 2-20).

B) Special Cases

1) Aqueous Liquids

The liquids were solidified in cement, double bagged, surrounded by absorbant, and placed in plastic-lined drums. The drum liner and the drum were sealed. The drum was shipped in a Model N-55 overpack.

OR

The liquids were solidifed in cement, surrounded by absorbent. The drum liner and the drum were sealed. The drum was surrounded by foam in a CSB. The CSB was shipped in a Model 6400 overpack.

2) Organic Liquids (Oil)

The liquids were mixed with absorbent in 1-gallon bottles which were double bagged and placed in a lined drum and surrounded by more absorbent. The liner and the drum were sealed. The drum was shipped in a Model N-55 overpack.

3) Mercury

The mercury was mixed with a mercury absorbent and double bagged. The double bag was surrounded by at least 6 inches of

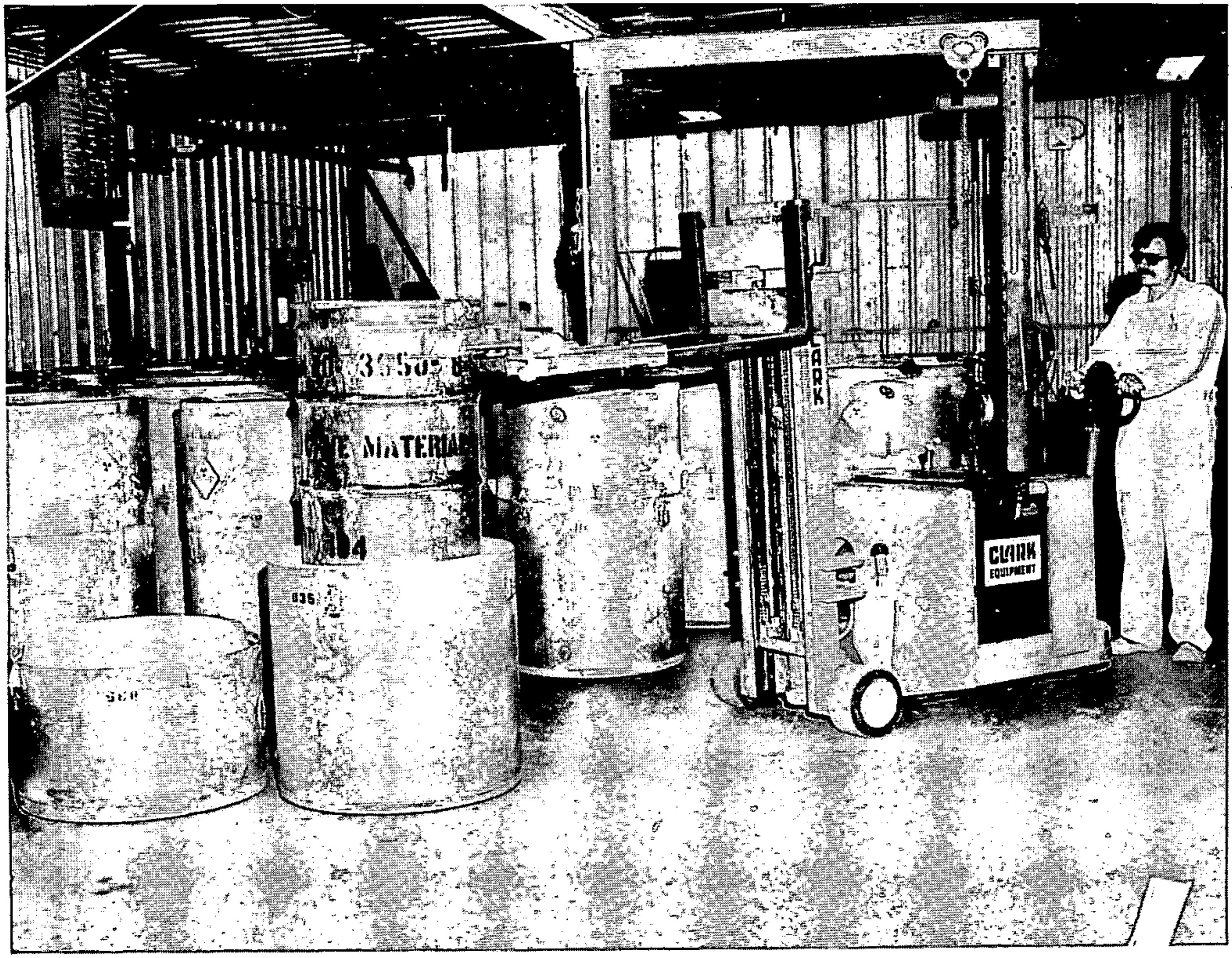


Figure 2-19. Loading Galvanized Drums into Model N-55 Overpacks

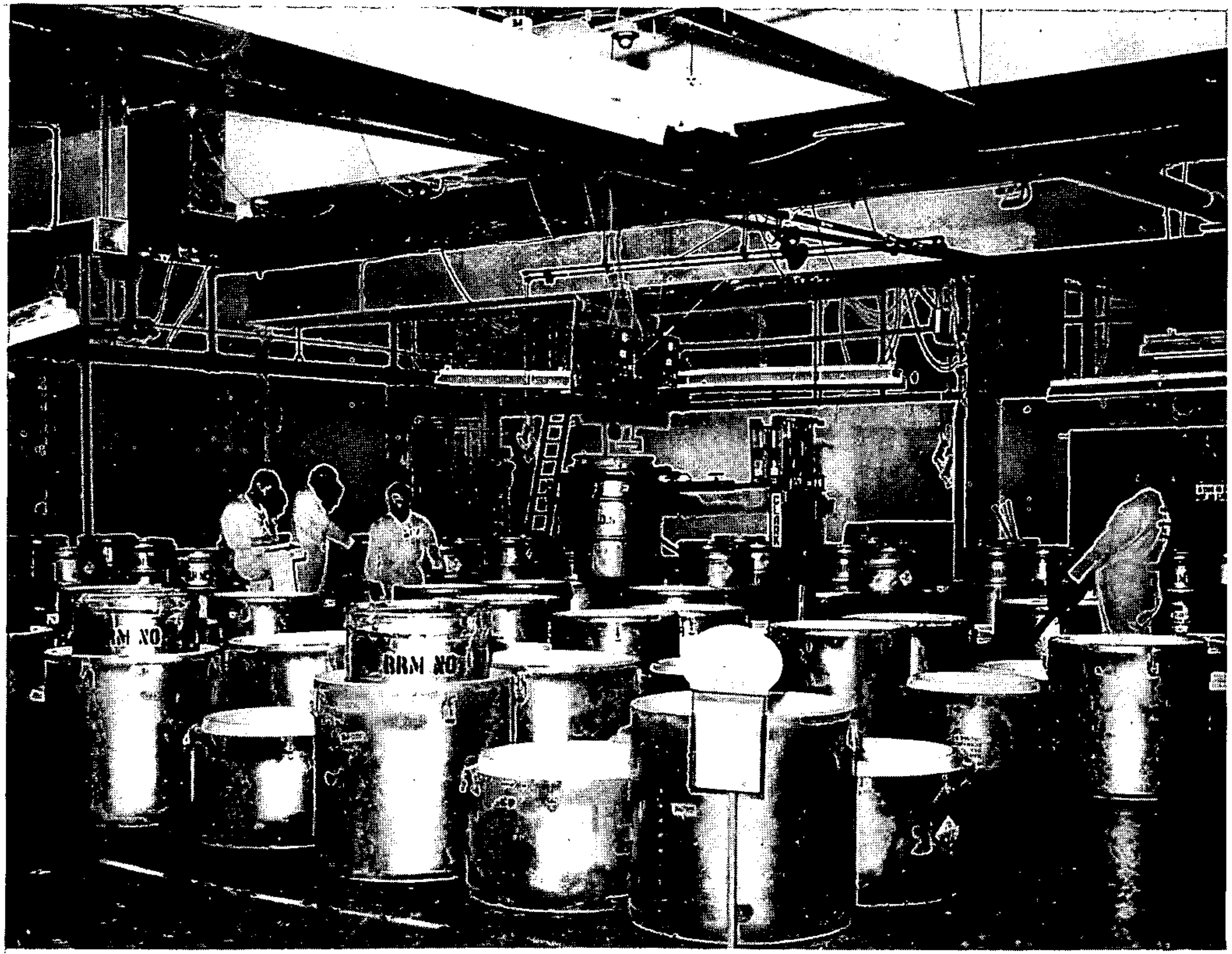


Figure 2-20. Loading Galvanized Drums into Model N-55 Overpacks

cement which was surrounded by absorbent. The liner and the drum were sealed. The drum was shipped in a Model N-55 overpack.

II) CSBs

Waste items were decontaminated to a smearable level of <150,000 dpm/100 cm^2 and coated with a fixing agent, until the smearable was <10,000 dpm/100 cm^2, and then double bagged.

OR

The inaccessible areas were filled with polyurethane foam (to fix the contamination) and the external surfaces were decontaminated to <150,000 dpm/100 cm^2 and coated with a fixing agent to smearable levels <10,000 dpm/100 cm^2. The item was then double bagged.

OR

DOT specification drums were loaded with solidified waste.

OR

Plywood boxes built to GE Drawing 272E81-28, Rev. 0 (see Appendix C), were loaded with double-bagged filters which were foamed in place in the plywood box.

The double-bagged waste items, the drums, or the boxes were loaded into the CSB and foamed in place (Figures 2-21 and 2-22). The lid was bolted in place (Figures 2-22 and 2-23). The steel box was shipped in a Model 6400 overpack.

III) FRPs

Waste items were decontaminated to a smearable level of <150,000 dpm/100 cm^2 and coated with a fixing agent until the smearable was <10,000 dpm/100 cm^2 and then double bagged.

OR

The inaccessible areas were filled with polyurethane foam (to fix the contamination) and the external surfaces were decontaminated to <150,000 dpm/100 cm^2 and coated with a fixing agent to smearable levels <10,000 dpm/100 cm^2. The item was then double bagged.

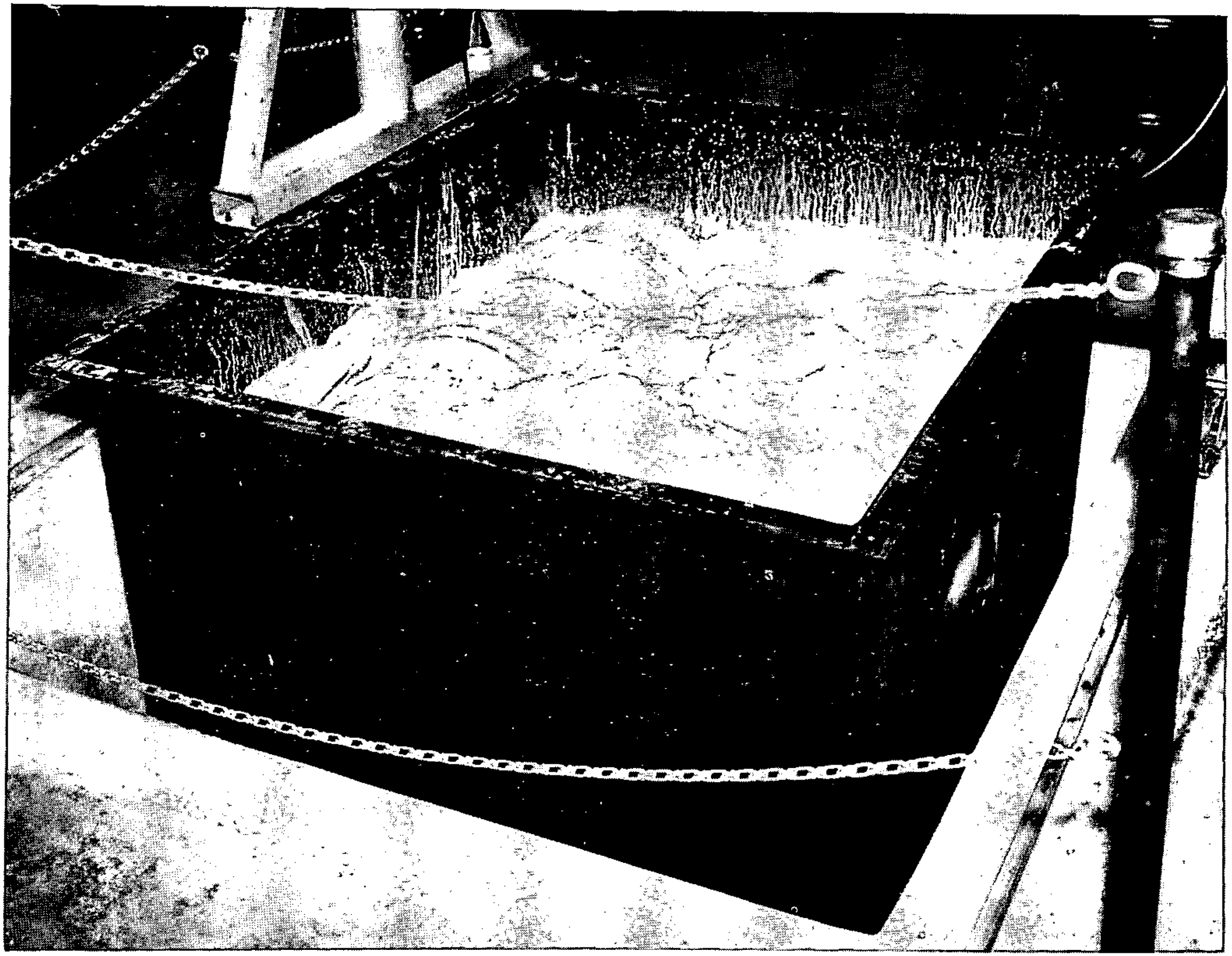
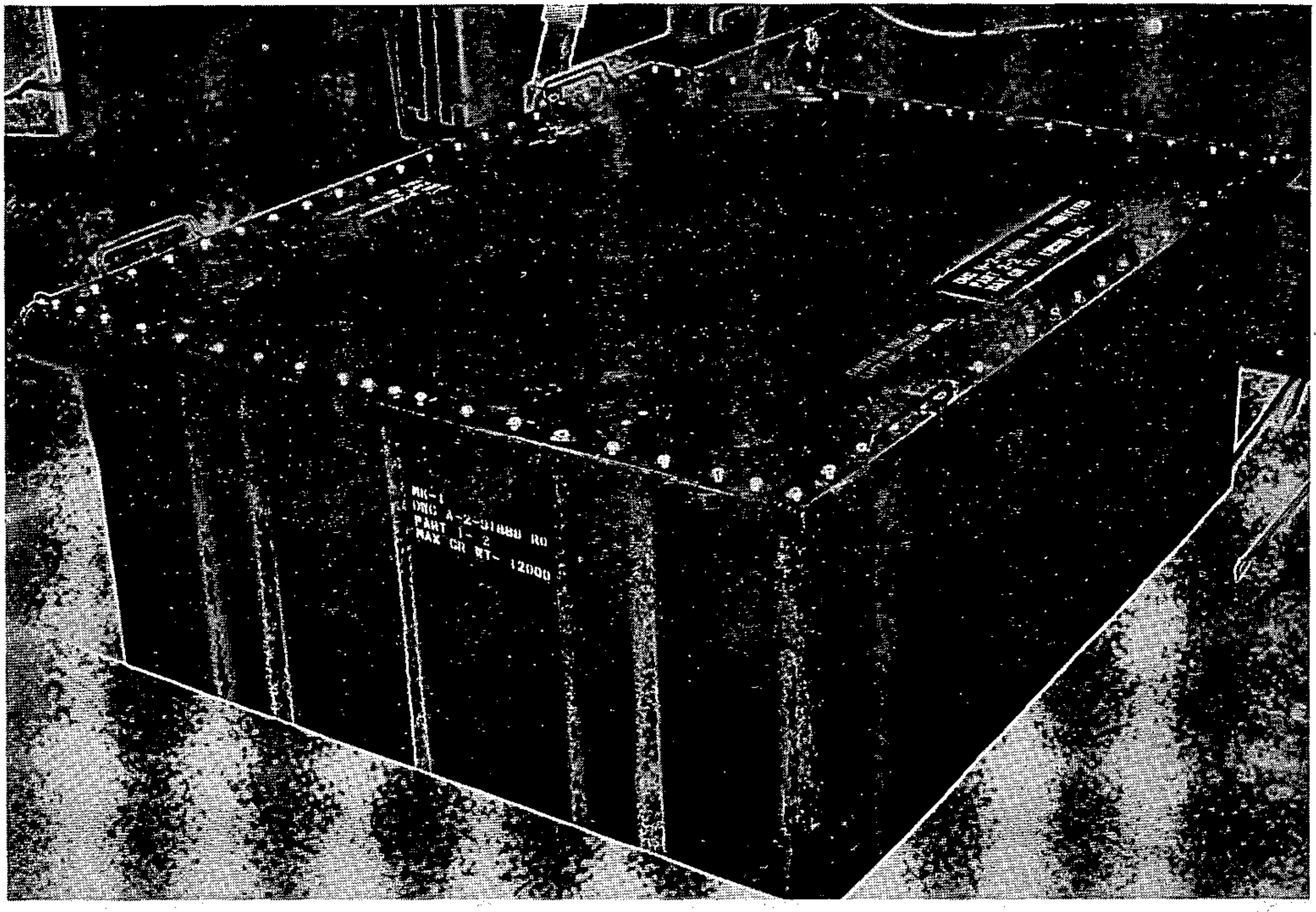


Figure 2-21. Loading of a CSB Container -- Foaming 55-Gallon Drums in Place



2-22. Loaded CSB Container with Sealed Lid Being Removed from the Loading Pit

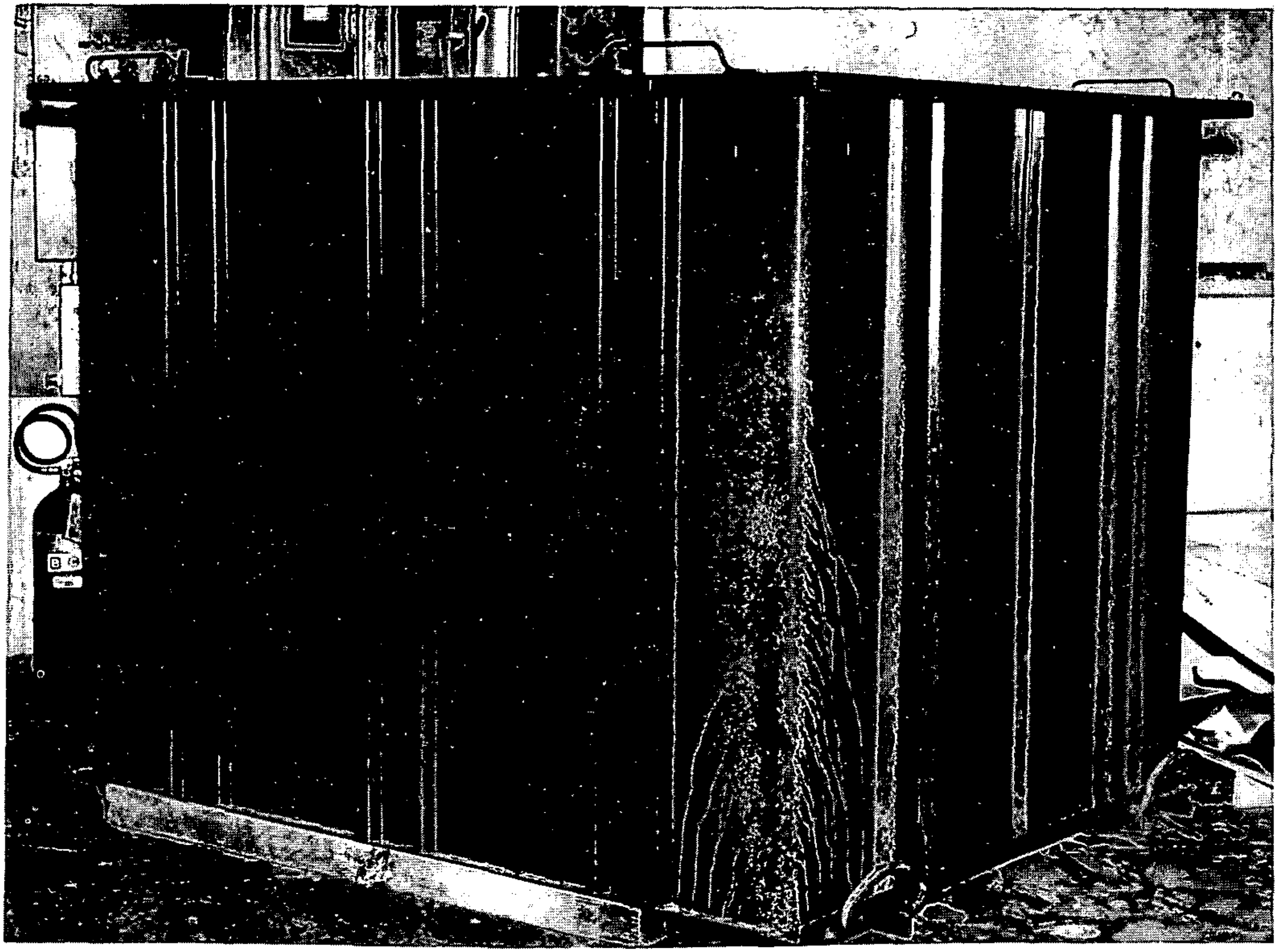


Figure 2-23. Loaded CSB Container Awaiting Shipment

The double-bagged waste items were loaded into the FRP and foamed in place (Figures 2-24 and 2-25). The lid was glued and nailed in place and the seam was sealed with fiberglass reinforced polyester resin (Figure 2-26). The plywood box was shipped in a Model 6400 overpack.

2.13.3 Transport Overpacks

Two overpack containers were selected to transport the TRU waste. These were the Model 6400 (USNRC Certificate of Compliance No. 6400) and the Model N-55 (USNRC Certificate of Compliance No. 9070). The waste must be packaged in specific containers prior to using these overpacks. Additional restrictions, such as weight and curies, also apply. The Model 6272 (USRNC Certificate of Compliance No. 6272) was approved for the transport of bins and drums (within a bin), but was not used. The certificates of compliance are attached as Appendix D.

2.13.3.1 Model N-55 Overpack -- The Model N-55 is a double-walled foam-filled steel container used to enclose a 55-gallon drum. Outside dimensions are 58 inches high by 32 inches in diameter. A gasketed lid is clamped to the body. Up to 76 overpacks are shipped in a closed trailer. Figures 2-19 and 2-20 show this overpack being loaded.

2.13.3.2 Model 6400 Overpack -- The Model 6400 overpack, which is also described as the Super Tiger, is a double-walled foam-filled steel container. The external dimensions are approximately 8 feet by 8 feet by 20 feet and the internal dimensions are approximately 6 feet by 6 feet by 14 feet. The lid, or cover, is held in place with steel bolts. Only one overpack is attached to a flatbed trailer for each shipment. Special packaging methods and containers are required for this overpack. The CSB or FRP containers are loaded into the cavity with a forklift truck and a specially constructed loading platform. They are then braced with inflated air bags to prevent movement during transport. Figures 2-27, 2-28, 2-29, and 2-30 show the loading of this overpack.

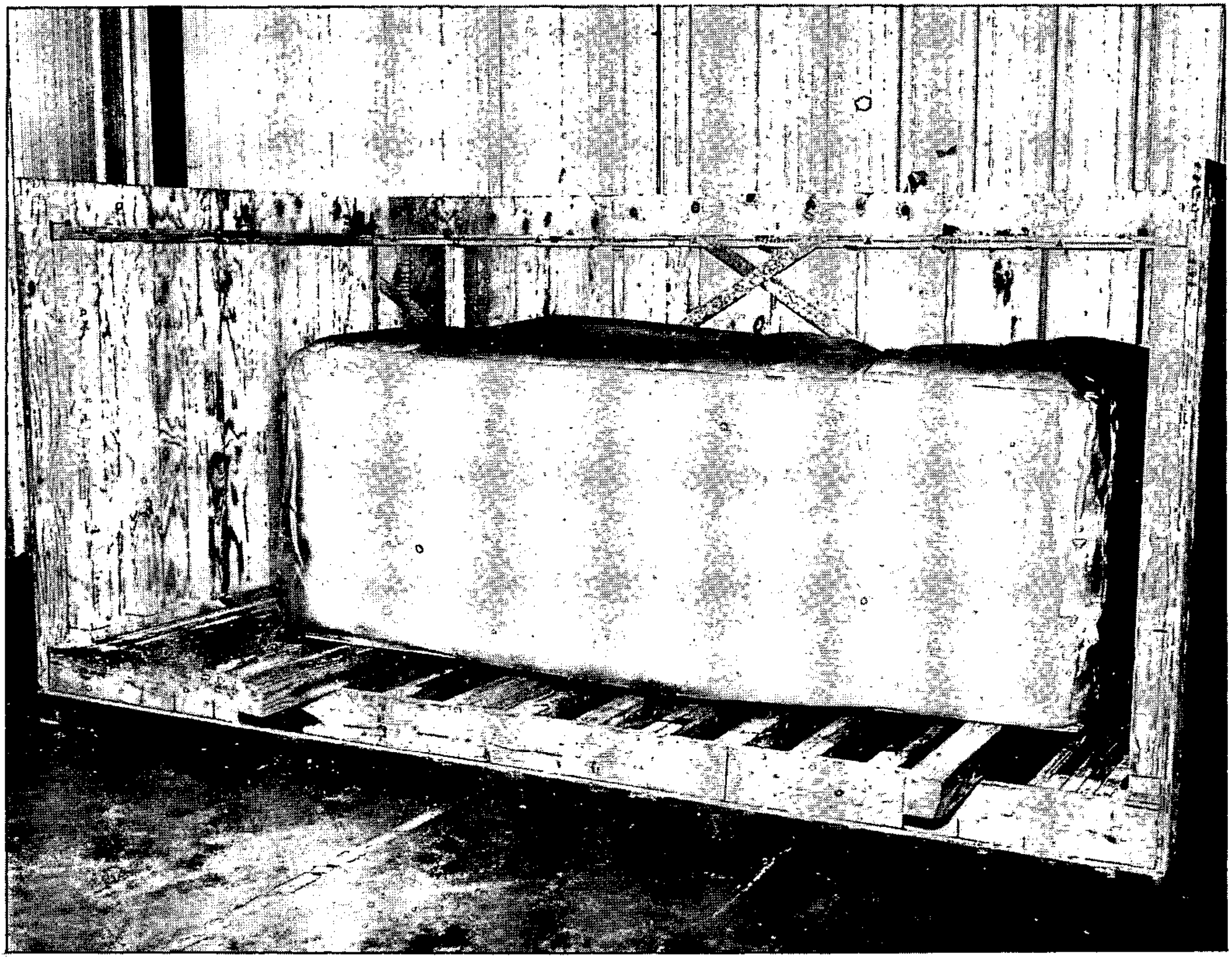


Figure 2-24. Plastic-Wrapped Analytical Lab Hood Being Loaded into FRP Container

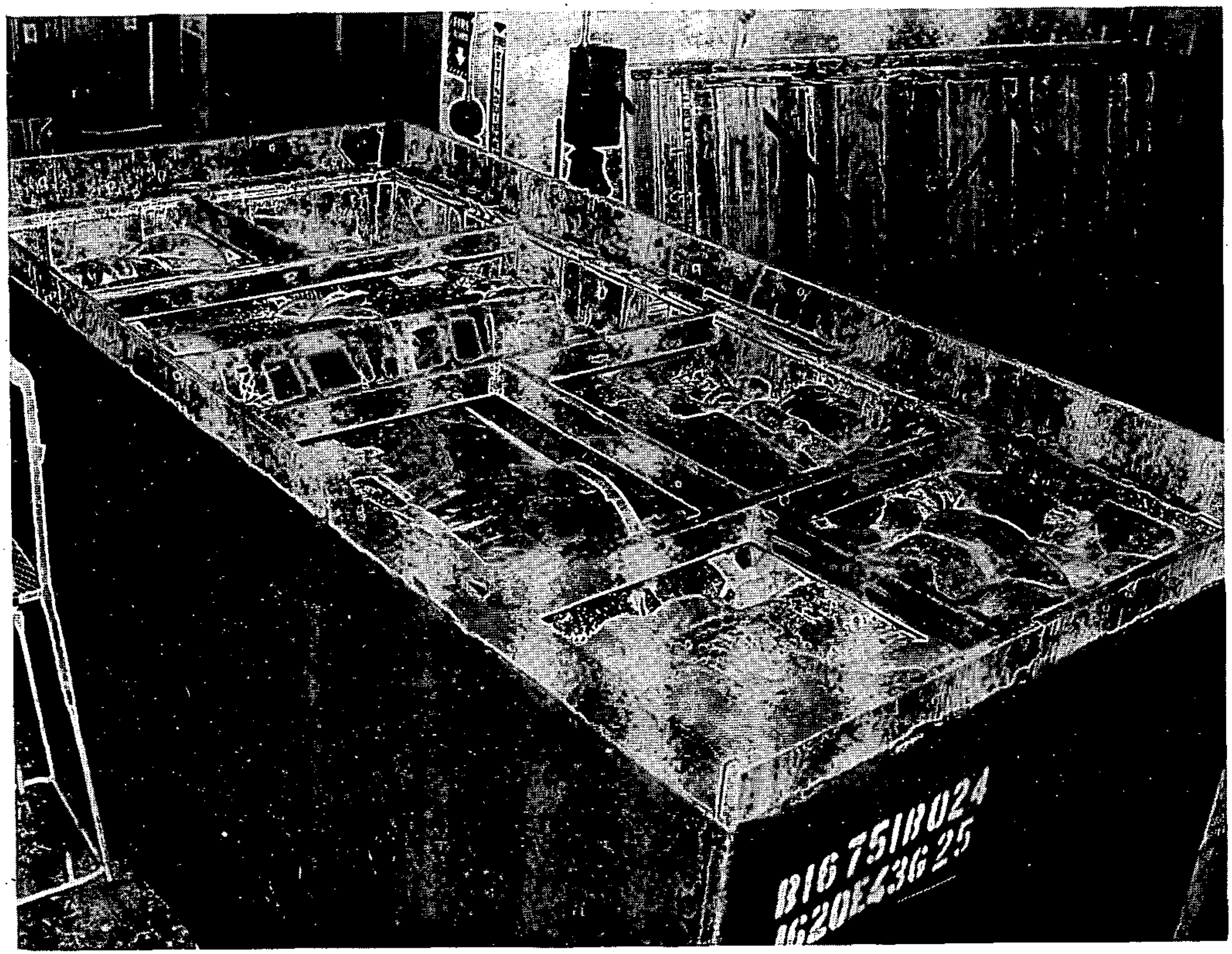


Figure 2-25. Plastic-Wrapped Packages Being Foamed in FRP Container

Figure 2-26. Loaded FRP Container Awaiting Shipment

Figure 2-27. CSB Container Being Loaded into a Model 6400 Overpack

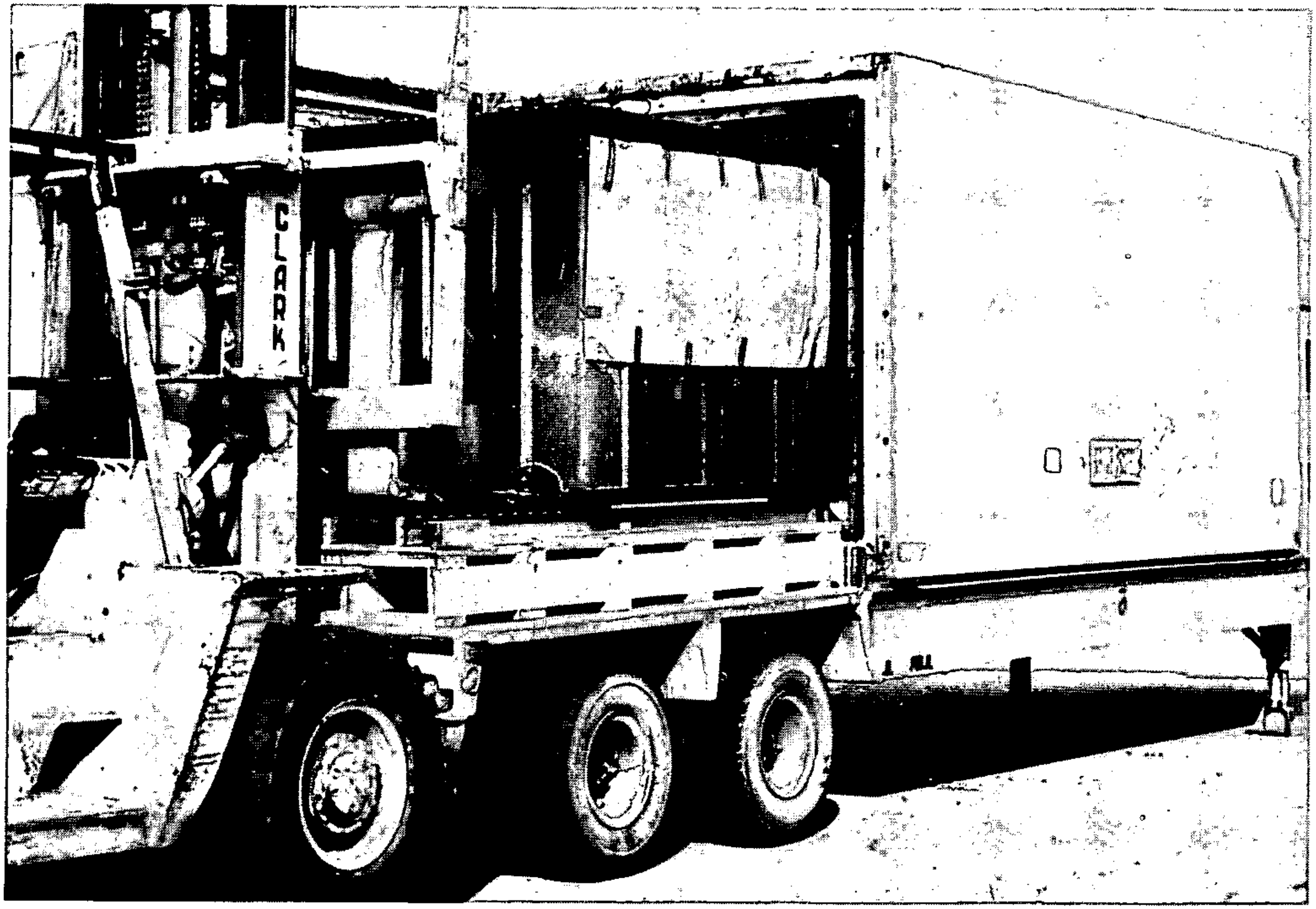


Figure 2-28. CSB Container Being Loaded into a Model 6400 Overpack, Showing Air Bags Prior to Inflation

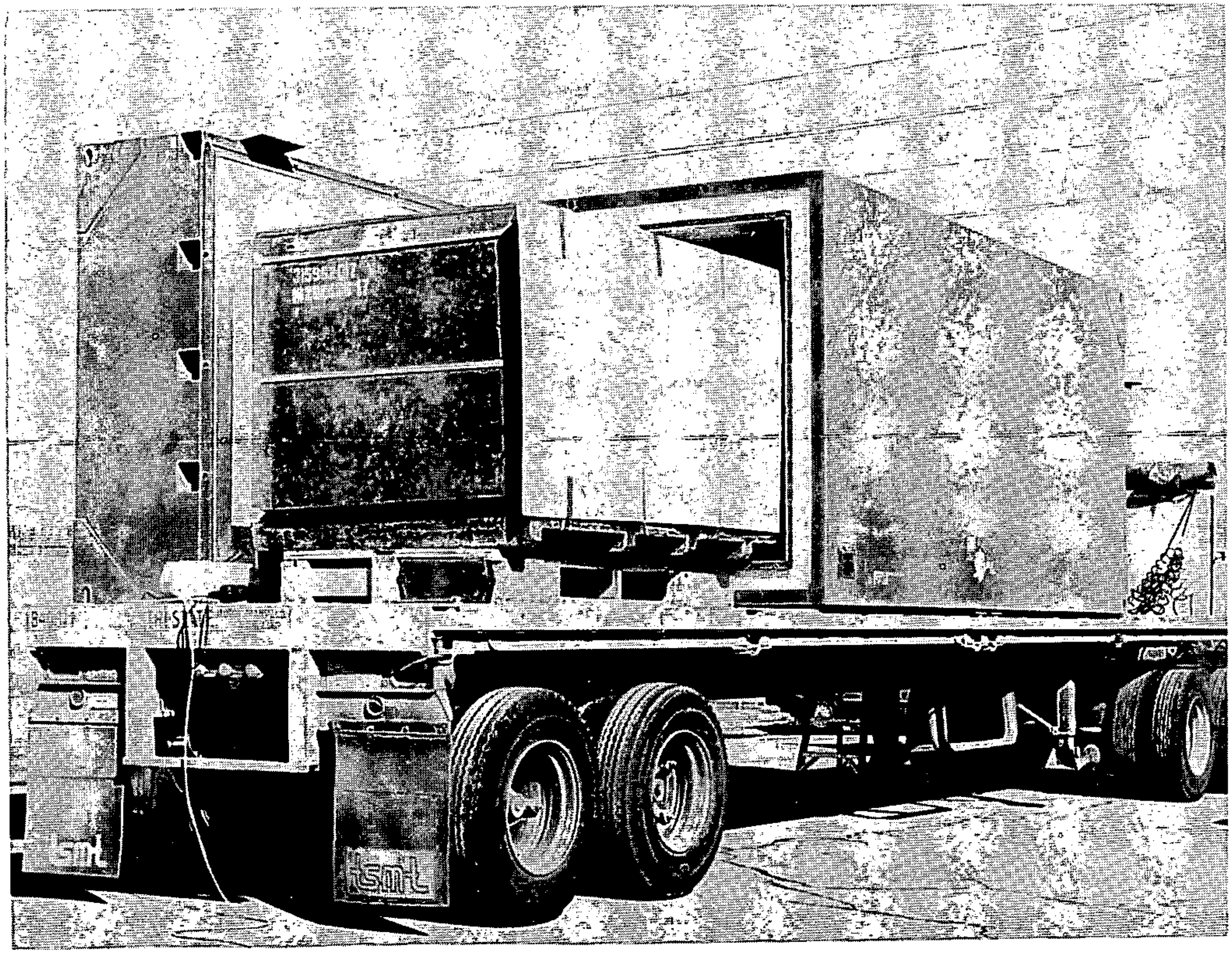


Figure 2-29. FRP Container Being Loaded into a Model 6400 Overpack

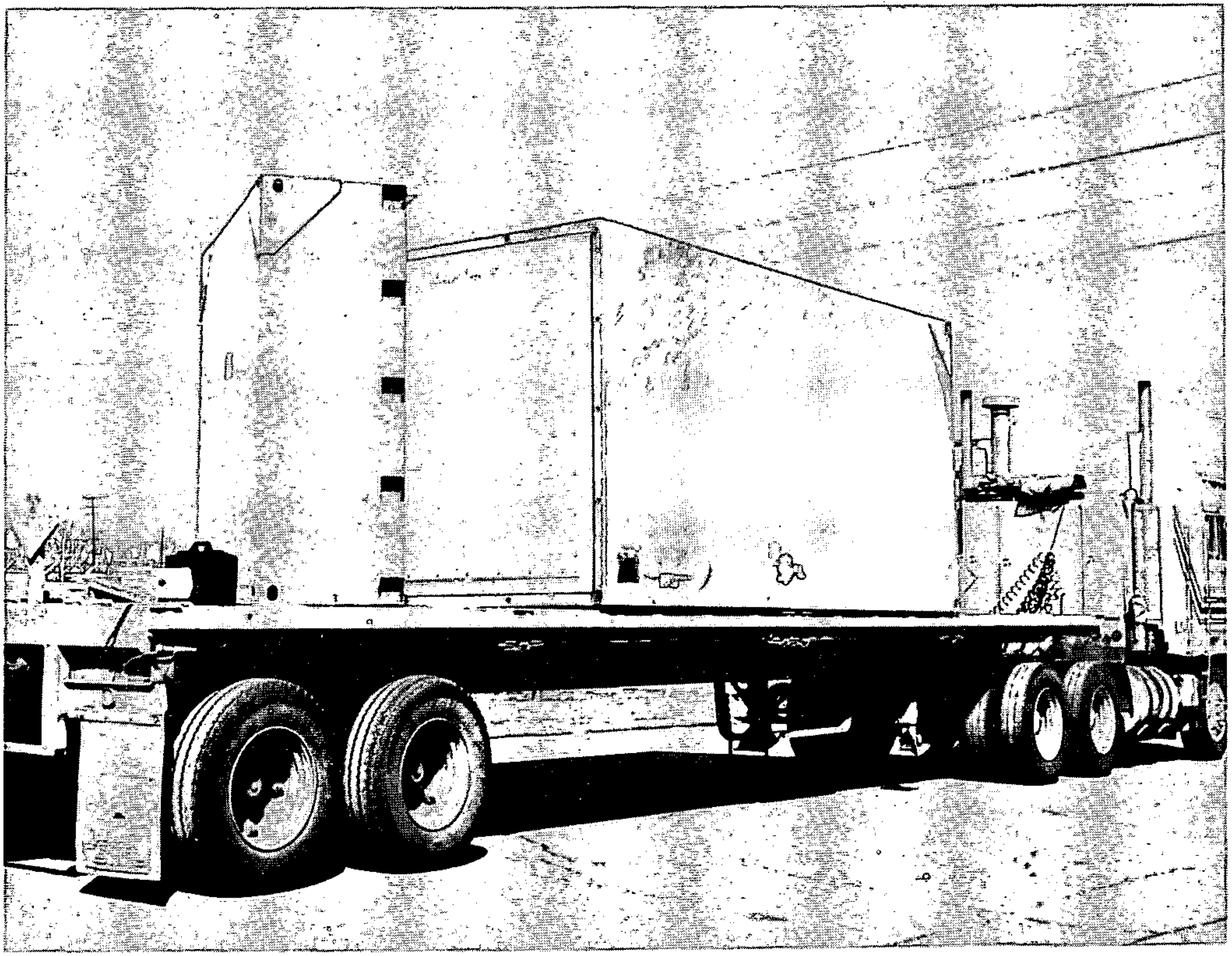


Figure 2-30. Loaded Model 6400 Overpack with Inner Door Closed

2.13.3.3 Model 6272 Overpack -- The Model 6272 overpack, which is also described as the Poly Panther, has a double-walled steel shell with polyurethane foam between the walls. The lid is held in place with steel rods. Enclosed within the overpack is a bolted and gasketed inner container which is a part of the shipping system. The dimensions of the overpack are approximately 5-1/2 feet by 6 feet by 7-1/2 feet. The dimensions of the inner container are approximately 4 feet by 5 feet by 6 feet. Up to 6 overpacks are attached to a flatbed trailer for each shipment. A crane is required to load the inner containers into the overpack.

2.13.4 Containers

The containers discussed below were approved for disposal at the Rockwell Hanford Operations Site. The requests for package approvals including drawings and specifications are attached as Appendix C. An approved transuranic waste container must be able to be removed intact from a 20-year burial. This requires rigid structural properties to withstand soil loading, and special coatings to withstand environmental attack. Table 2-6 describes the containers approved for this contract including restrictions and special requirements for the use of each container. Also included are the vendors and the price per unit for the containers used for this contract.

2.13.5 Shipments

The transuranic waste shipments for this contract are summarized in Table 2-7.

The nontransuranic waste shipments for this contract are summarized in Table 2-8.

2.14 RADIATION EXPOSURE OF PERSONNEL

2.14.1 Protective Equipment

2.14.1.1 Protective Clothing -- All personnel working in contaminated or potentially contaminated areas at the PFDL wore protective clothing as covered

TABLE 2-6

APPROVED BURIAL CONTAINERS FOR SHIPPING ALL TYPES OF WASTE TO RHO FOR BURIAL

Container	Package Approvals	Drawing Specification	Volume	Maximum Weight	Quantities	Supplier	Cost
Galvanized Steel Drum	#1, Rev. 3 #9, Rev. 0	DOT 17C RHO HS-BP-008	7.5 ft^3	550# (N-55)	20 Ci	FBF, Inc., Middle Brook Industrial Park, 1201 Hilton Rd., Knoxville, TN	$65
Corrugated Steel Box	#7, Rev. 0	RHO Dwg. H-2-91888 As Modified	227 ft^3	12,000#	200 g	Reynolds, Mfg. Co. Avonmore, PA 15618	$4,900
FRP	#8, Rev. 0	(W) Dwg. 1620E43 Sub 3, G25	345 ft^3	5,000#	200 g	A. K. Fiberglastics 8300 Dayton Spring-field Road Fairborne, OH 45324	$3,700
Painted Drum	#5, Rev. 0	DOT 17C	7.5 ft^3	840#	LSA	FBF, Inc.	$30
M III	#5, Rev. 0	ANL Dwg. CS-2273	125 ft^3	3,000#	LSA	Not Used	Not Used
Wooden Box	#6, Rev. 0	Mound Dwg. AYD 750375	170 ft^3	5,000#	LSA	Not Used	Not Used
Wooden Box	#6, Rev. 0	(W) Dwg. 2044F14	170 ft^3	4,000#	LSA	Not Used	Not Used

TABLE 2-7

SUMMARY OF TRU WASTE SHIPMENTS TO RHO FOR BURIAL

Shipment Description	Number of Containers	SNM Shipped Pu (gr)	SNM Shipped ^{235}U (gr)	Radio-activity Shipped (Curies)	Weight Shipped (Pounds)	Volume Shipped (ft^3)	Categorized Waste Volumes (ft^3) Metal	Plastic	Cement	Paper	Wood	Rubber	Glass	Paint	Brick	Plaster	Cloth	Absorbed Oil	Granite	Dirt	Leather	Absorbent	Asbestos	Graphite
FRP #1	1	56	36	58.7340	4991	345	341.14	1.24	-	0.48	-	0.28	0.31	-	-	-	-	-	-	-	-	-	-	1.55
FRP #2	1	<1	<1	0.2800	4877	345	345.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal FRPs	2	56	36	59.0140	9868	690	686.14	1.24	-	0.48	-	0.28	0.31	-	-	-	-	-	-	-	-	-	-	1.55
CSB #1	2	<1	<1	1.0800	8156	454	390.58	38.23	-	-	-	-	25.20	-	-	-	-	-	-	-	-	-	-	-
CSB #2	2	1	<1	1.3000	8612	454	397.46	48.69	-	-	-	-	7.85	-	-	-	-	-	-	-	-	-	-	-
CSB #3	2	196	-	690.4000	17328	454	-	-	454.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #4	2	198	-	757.6800	16520	454	-	-	454.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #5	2	191	-	740.0000	16878	454	-	-	454.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #6	2	2	-	8.2400	10422	454	261.21	162.23	-	-	30.55	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #7	2	2	-	17.2100	10806	454	341.27	110.98	-	-	-	-	-	-	-	-	-	-	1.75	-	-	-	-	-
CSB #8	2	6	-	14.8700	10332	454	328.71	125.29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #9	2	130	17	482.7000	10920	454	136.36	90.64	227.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #10	2	372	24	1897.2000	9894	454	138.88	88.12	227.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #11	2	1	-	2.8250	8874	454	331.42	122.58	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #12	2	3	-	5.8874	13500	454	286.79	33.87	-	-	-	-	-	-	113.50	-	-	-	19.79	-	-	-	-	-
CSB #13	2	5	-	15.1422	9668	454	345.13	108.87	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #14	2	5	-	12.3554	6676	454	452.52	1.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #15	2	4	-	13.4386	8140	454	344.81	109.19	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #16	2	1	-	7.2212	9520	454	356.28	97.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #17	2	1	-	5.3537	8968	454	128.07	306.25	-	-	19.68	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #18	2	1	-	7.1797	8008	454	190.89	263.11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #19	2	<1	-	2.0752	7128	454	175.65	215.06	-	-	63.29	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #20	2	1	-	4.6482	7992	454	303.88	150.12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #21	2	<1	-	2.5317	8004	454	342.52	111.48	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #22	2	<1	-	2.9183	8020	454	172.59	70.62	-	47.62	163.17	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #23	2	1	-	2.0141	7654	454	447.92	4.72	-	-	1.41	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #24	2	1	-	1.1099	7030	454	243.16	-	-	50.37	160.44	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #25	2	1	-	3.1238	7488	454	194.81	-	-	119.40	139.79	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #26	2	1	-	2.2607	7526	454	172.57	-	-	122.90	151.05	7.45	-	-	-	-	-	-	-	-	-	-	-	-
CSB #27	2	1	-	1.4798	7596	454	196.85	-	-	116.86	140.29	-	-	-	-	-	-	-	-	-	-	-	-	-
CSB #28	2	1	-	1.0688	7417	454	275.92	2.97	-	109.07	66.03	-	-	-	-	-	-	-	-	-	-	-	-	-
Subtotal CSBs	56	1120	41	3252.8537	269077	12712	6956.25	2262.22	1816.00	566.22	935.70	7.45	33.04	-	113.40	-	-	-	21.54	-	-	-	-	-
Drum #1	76	248	22	670.3014	19073	570	384.12	53.81	0.23	71.71	2.51	41.55	6.10	-	6.04	-	2.79	-	-	-	0.46	0.68	-	-
Drum #2	76	66	8	185.5843	15213	570	276.39	94.91	-	136.52	13.57	42.64	1.26	-	3.19	-	0.97	-	-	-	0.23	0.34	-	-
Drum #3	76	70	6	174.1868	11994	570	88.66	179.30	-	194.14	3.10	71.06	2.03	5.81	-	-	1.32	24.33	-	-	-	0.24	-	-
Drum #4	38	31	-	100.4463	7479	285	141.85	50.45	0.23	45.02	0.15	16.14	0.12	-	13.10	-	17.94	-	-	-	-	0.01	-	-
Drum #5	38	48	-	200.7716	7804	285	97.70	44.64	4.24	64.55	18.04	27.45	24.48	-	1.47	-	0.41	-	-	-	-	-	1.93	-
Drum #6	76	42	-	182.8981	17987	570	185.82	113.47	57.17	59.81	2.63	45.93	87.70	11.81	-	-	3.78	-	-	-	0.72	0.79	0.38	-
Drum #7	76	227	-	894.0836	14922	570	256.52	66.83	13.40	57.07	6.37	28.23	72.82	15.55	-	44.76	2.61	-	-	-	5.79	0.11	-	-
Drum #8	31	53	-	214.4628	5958	232.5	96.96	35.36	0.27	29.19	4.69	29.08	27.55	7.50	-	-	1.27	-	-	-	-	0.64	-	-
Drum #9	31	<1	-	0.9359	5097	232.5	43.54	89.56	7.50	38.90	29.55	17.45	-	5.95	-	-	-	-	-	-	-	-	-	-
Drum #10	32	<1	-	1.3595	4995	240	135.87	48.39	7.50	11.75	-	6.50	-	30.00	-	-	-	-	-	-	-	-	-	-
Drum #11	32	2	-	9.7850	6292	240	5.18	123.48	15.00	40.94	1.16	28.28	-	25.97	-	-	-	-	-	-	-	-	-	-
Drum #12	32	<1	-	2.5097	5606	240	20.23	100.60	2.50	20.89	-	15.87	-	55.36	-	20.00	4.57	-	-	-	-	-	-	-
Drum #13	32	<1	-	3.3323	6914	240	69.36	5.34	122.19	3.43	1.21	0.54	-	-	-	37.50	0.42	-	-	-	-	-	-	-
Drum #14	32	60	49	61.5339	7374	240	49.61	70.85	37.23	23.90	8.05	0.94	1.25	6.01	-	-	13.67	9.45	-	16.75	2.25	-	-	-
Subtotal Drums	678	847	85	2702.1912	136708	5085	1851.81	1076.99	267.46	797.82	91.03	371.66	223.31	163.96	23.80	102.26	49.85	33.78	-	16.75	9.45	2.81	2.31	-
Totals	736	2023	160	6014.0589	415653	18487	9494.20	3340.45	2083.46	1364.52	1026.73	379.39	256.67	163.96	137.30	102.26	49.85	33.78	21.54	16.75	9.45	2.81	2.31	1.55
(Volume %)							(51.36%)	(18.07%)	(11.27%)	(7.38%)	(5.55%)	(2.05%)	(1.39%)	(0.89%)	(0.74%)	(0.55%)	(0.27%)	(0.18%)	(0.12%)	(0.09%)	(0.05%)	(0.02%)	(0.01%)	(0.01%)

TABLE 2-8

SUMMARY OF NON-TRU WASTE SHIPMENTS TO RHO FOR BURIAL

Shipment	Number of Containers	Radioactivity Shipped mCi	Weight Shipped Pounds	Volume Shipped (ft^3)	Categorized Waste Volumes (ft^3)								
					Paper	Plastic	Rubber	Metal	Cloth	Dirt	Cement	Wood	Leather
#1	150	46.11278	19.157	1125	374.96	382.50	329.96	37.47	-	-	-	-	-
#2	70	46.12186	14.359	525	115.03	98.07	56.07	128.94	73.97	27.77	22.10	2.26	0.74
Totals	220	92.23464	33.516	1650	489.99	480.57	386.03	166.40	73.97	27.77	22.10	2.26	0.74
(Volume %)					(29.70%)	(29.13%)	(23.40%)	(10.09%)	(4.48%)	(1.68%)	(1.34%)	(0.14%)	(0.04%)

under the administrative exposure controls described in Section 6 of the Cheswick Site Health Physics Manual. The rationale for such use, description of the means and extent of such clothing, and methods of controlling spread of contamination and internal exposure are described briefly in the following excerpt from the Cheswick Site Health Physics Manual:

"Protective clothing is used by employees to reduce their exposure to radioactive materials, to prevent ingestion, to prevent the contamination of their bodies or personal clothing, and to aid in the confinement of contamination to a specific area. Ingestion is prevented by good personal hygiene practices and by complying with work regulations that apply to eating, smoking, etc. in radioactively contaminated areas.

"The term 'protective clothing' may be somewhat misleading when applied to clothing worn while working with radioactive materials. Except for its ability to stop alpha particles and soft beta radiation, protective clothing affords little protection from external radiation. However, such clothing does provide:

"1. Protection from direct skin contact with radioactive materials, thereby helping to prevent continuing (though usually minor) radiation exposure due to contamination of the employee's body.

"2. A means of preventing the contamination of personal clothing, thereby aiding in confining the contamination to specific areas by restricting the contaminated protective clothing to these areas.

"All personnel in contaminated or potentially contaminated areas must wear the protective clothing designated by Industrial Hygiene as necessary or required in the performance of their duties; this applies to employees assigned to work in the area and also casual visitors to these areas. Casual visitors are those persons who enter the area for observation, supervision, or other reasons which do not entail their working with or in the equipment, facilities, and materials in the area. Visitors are normally required to wear laboratory coats and shoe covers, unless otherwise specifically stated at the work area entrance. Employees assigned to work in the area are normally required to wear underwear, socks, coveralls, and safety shoes. Rubber or vinyl gloves may be required in some areas. Protective clothing is used in contaminated areas and must not be worn outside of these areas.

"Protective clothing is laundered by a company that is licensed by the NRC to perform such work. This company picks up the contaminated clothing at regular intervals from designated pick-up stations throughout the plant. The laundry should be segregated as to type and contamination levels. After laundering, it is returned to these stations by the supplier. The supplier of this laundry service is selected by one designated supervisor in each division, subject to approval of the Supervisor of Industrial Hygiene."

Outgoing (dirty) and incoming (clean) laundry was checked by Health Physics to assure that contamination limits according to Section 6.4 of the Cheswick Site Health Physics Manual were not exceeded.

2.14.1.2 Respiratory Protection

The use of respiratory protection equipment on the Cheswick Site was carried out in accordance with the Cheswick Site Respiratory Protection Manual. The basic policy of respiratory protection is provided in Section 2.0 of the Cheswick Site Respiratory Protection Manual, as given below:

> "The primary objective of the respiratory protection program is to limit the inhalation of airborne hazardous materials. This is normally accomplished by application of engineering controls in the choice of process, containment, and ventilation equipment. When such controls are not feasible or cannot be applied, the use of respiratory protective devices may be appropriate. Respirator usage shall be kept to a minimum."

In certain operations during the decontamination and decommissioning process at PFDL, the full use of ventilation and other engineered controls was insufficient to maintain airborne contamination levels to less than maximum permissible concentration (MPC) limits in breathing air work zones. Sectioning of glove boxes and removal of liquid process lines are examples of two operations where this was the case.

A listing of Industrial Hygiene procedures pertaining to respiratory protection is provided in Table 2-9 and the detailed procedures are presented in Appendix B.

Although all of the above procedures pertain in some degree to the respiratory protection program, Industrial Hygiene Procedure No. CS-IH-0708 was written especially for the sectioning of glove boxes and was used throughout for all sectioning operations of contaminated equipment and materials.

There was also a training program carried out to give special safety instructions on the use of full face respirators for the D&D operations at PFDL. This training program is included in Appendix E.

TABLE 2-9

CHESWICK SITE INDUSTRIAL HYGIENE PROCEDURES
PERTAINING TO RESPIRATORY PROTECTION

Procedure Number	Title
CS-IH-0201	Inventory of Emergency Equipment and Supplies
CS-IH-0202	Air Investigative Reports
CS-IH-0301	Stack Effluent and Room Air Monitoring for PFDL, Building 8
CS-IH-0501	Bioassay Sampling
CS-IH-0502	Criteria for Performing Bioassay Following an Unusual Occurrence Involving Personnel Exposed to Radioactive Material
CS-IH-0701	Testing of Personnel in Respiratory Protection Test Chamber
CS-IH-0702	Medical Approval for Using Respiratory Protection Devices
CS-IH-0703	Selection of Respiratory Protection Equipment
CS-IH-0704	Issuance of Respiratory Protection Equipment
CS-IH-0705	Inspection of Respiratory Protection Equipment
CS-IH-0706	Maintenance of Respiratory Protection Equipment
CS-IH-0708	Respiratory Protection for the Sectioning of Glove Boxes
CS-IH-0810	Minimum Detectable Activity for Counting Systems

2.14.2 Air Sampling Program

Approximately 14,000 air samples were taken and analyzed in 1982* to monitor air within the working environment, compared to approximately 20,000 air samples for previous years. Given the total containment concept within a plutonium facility, the bulk (about 99.7 percent) of these air samples over the past five years has been less than the maximum permissible concentration (MPC) allowed by the regulations. The majority of those room samples measured fell below the minimum detectable activity (MDA) concentration**.

Approximately 40 percent of the room air samples taken were in areas where the transportable (soluble in body fluids) form of plutonium would be expected. The remaining 60 percent were in the areas where nontransportable forms of plutonium would be expected. This gives an additional degree of conservatism for many areas in that the lowest maximum permissible concentration appropriate for transportable forms of plutonium has been used throughout the plutonium laboratories. Whenever an air sample within the laboratories was greater than an established action level***, an "Air Sample Investigation Form" was completed which established a management review of the situation and noted any corrective actions taken.

The air sampling program is described more fully in Industrial Hygiene Procedure CS-IH-0301. The "fixed" air sample locations were designated by number and were located on a plan view of the PFDL Facility. These locations changed during D&D operations. Therefore, three sets of typical air sample

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* Comparable values for 1983 are not available at this time; however, these values will be included in the 1983 ALARA program report which will be completed and released prior to 9/30/84.

** Since approximately February 1980, the MDA values for room air have been 1.1×10^{-13} µCi/cc or 5.5% of the occupational MPC for soluble forms of plutonium and 0.3% of insoluble forms. Prior to this, the MDA was 2.0×10^{-13} µCi/cc.

*** The action levels were taken as 50 percent of the MPC for soluble plutonium in the plutonium laboratories or 50 percent of the lowest MPC for uranium in the uranium laboratories.

location diagrams are presented in Figures 2-31 through 2-36. Figures 2-31, 2-33, and 2-35 are schematic drawings of room air sample locations, and Figures 2-32, 2-34, and 2-36 show locations of stack air samples for the periods of 3/25/80, 10/26/81, and 3/31/83, respectively.

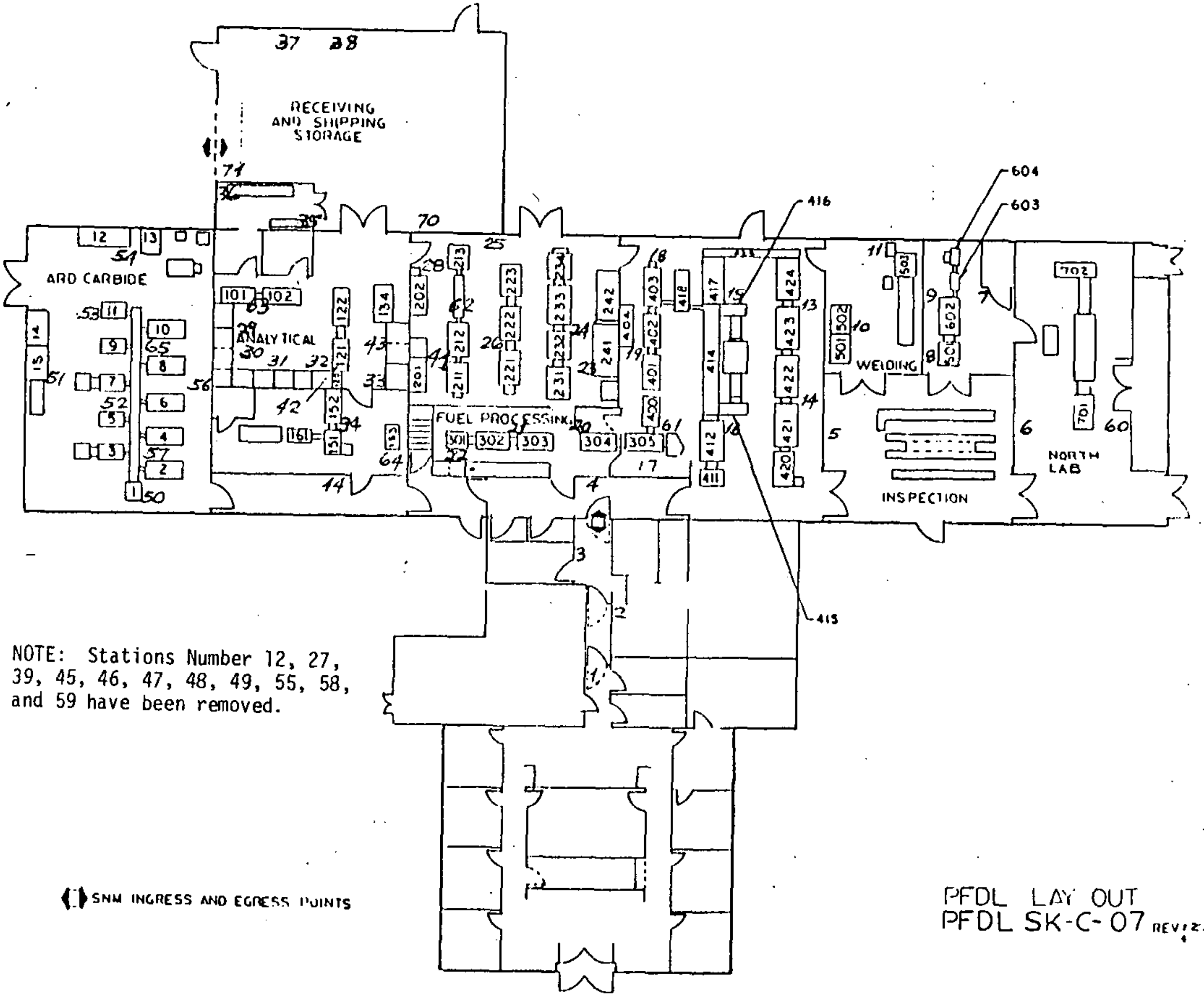
2.14.3 Bioassay and In Vivo Measurements

Urine bioassay samples were collected routinely on a quarterly basis for all personnel working in potentially contaminated areas.

Once a year, laboratory personnel who had some potential during the year for uptake of radioactive material were counted on a portable, mobile counter or at the University of Pittsburgh Low-Level Radiation Monitoring Facility. For those personnel working full time in sectioning operations, whole body counts were performed on a quarterly basis at the University of Pittsburgh Low-Level Radiation Monitoring Facility. In the case of an unusual occurrence where there was a high potential that a significant intake occured, special bioassay procedures were set up for evaluating the internal exposure. The methods for how and when to do such special bioassays can also be used to assess an individual's internal exposure.

2.14.4 Personnel Dosimetry

2.14.4.1 Body Badges -- A body badge personnel dosimetry program was provided by the Supervisor of Industrial Hygiene and his personnel. A commerical vendor selected by the Supervisor of Industrial Hygiene furnished the badges and processed them. Body badges were used to monitor the external radiation exposure of individuals. The badges were provided so that a complete record of each person's radiation exposure could be obtained.



NOTE: Stations Number 12, 27, 39, 45, 46, 47, 48, 49, 55, 58, and 59 have been removed.

SNM INGRESS AND EGRESS POINTS

PFDL LAY OUT
PFDL SK-C-07 REV

Figure 2-31. PFDL Room Air Sampling Locations, March 25, 1980

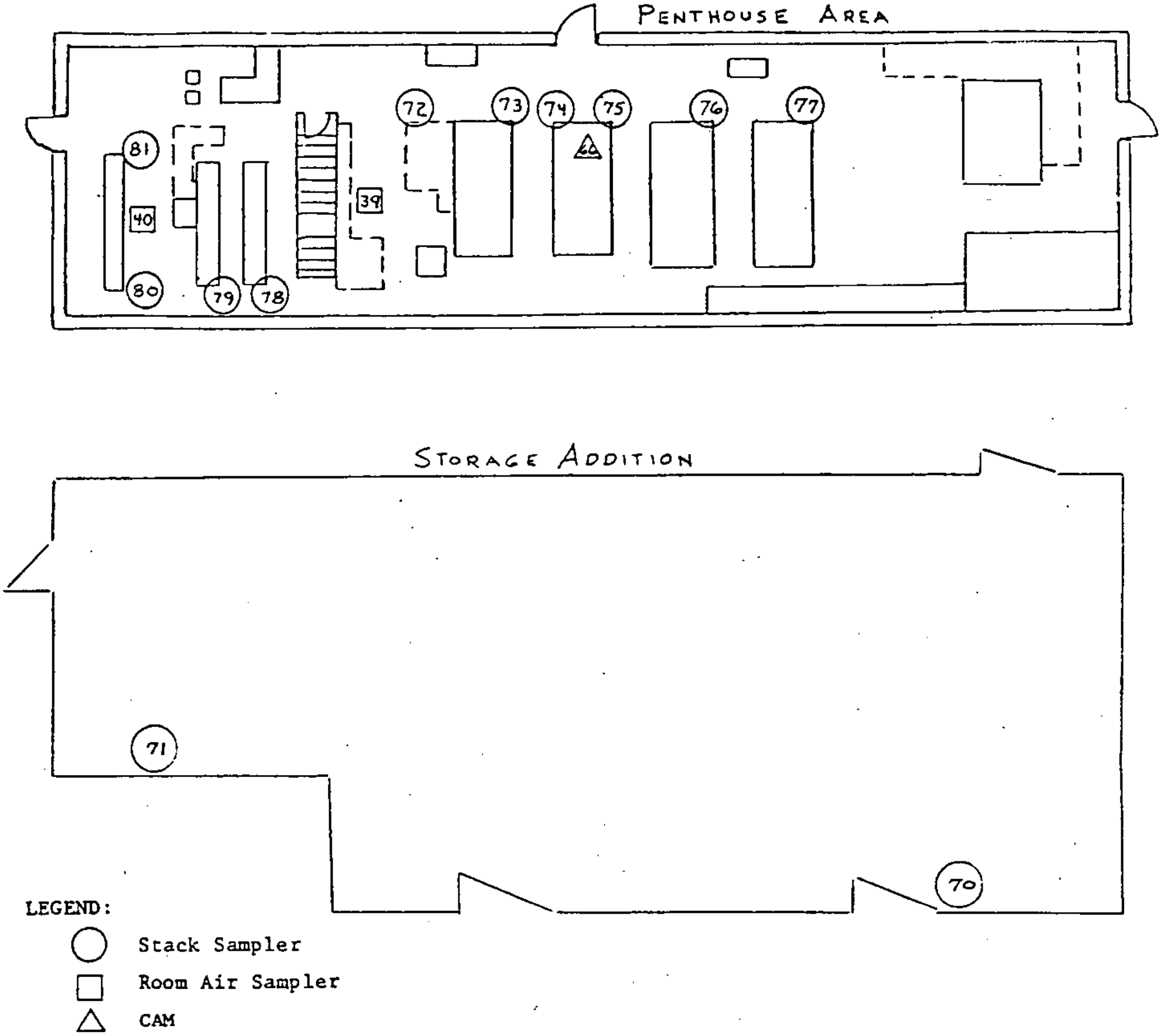
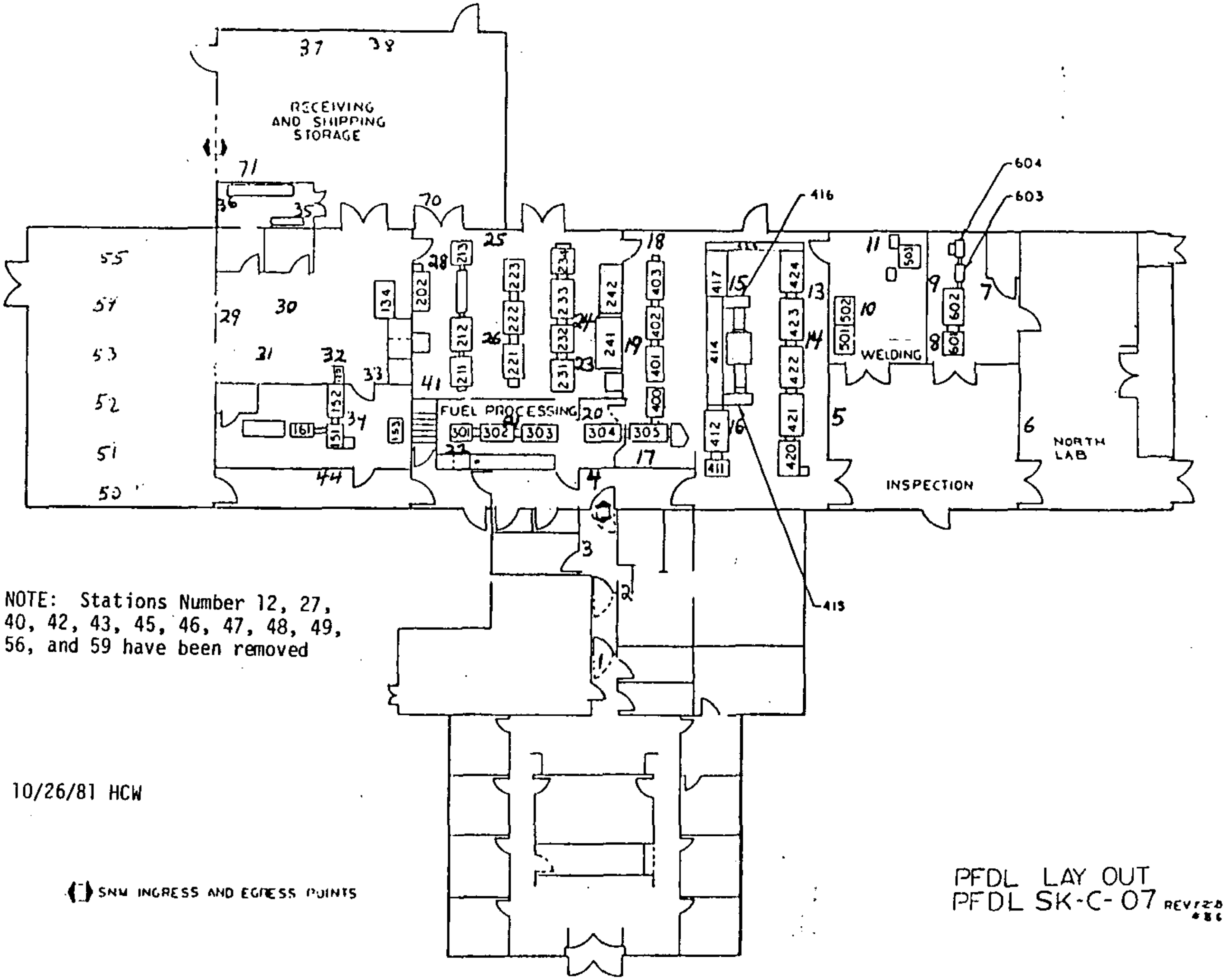


Figure 2-32. Location of PFDL Stack Air Sampling Stations, in Penthouse, March 25, 1980



NOTE: Stations Number 12, 27, 40, 42, 43, 45, 46, 47, 48, 49, 56, and 59 have been removed

10/26/81 HCW

Figure 2-33. PFDL Room Air Sampling Locations, October 26, 1981

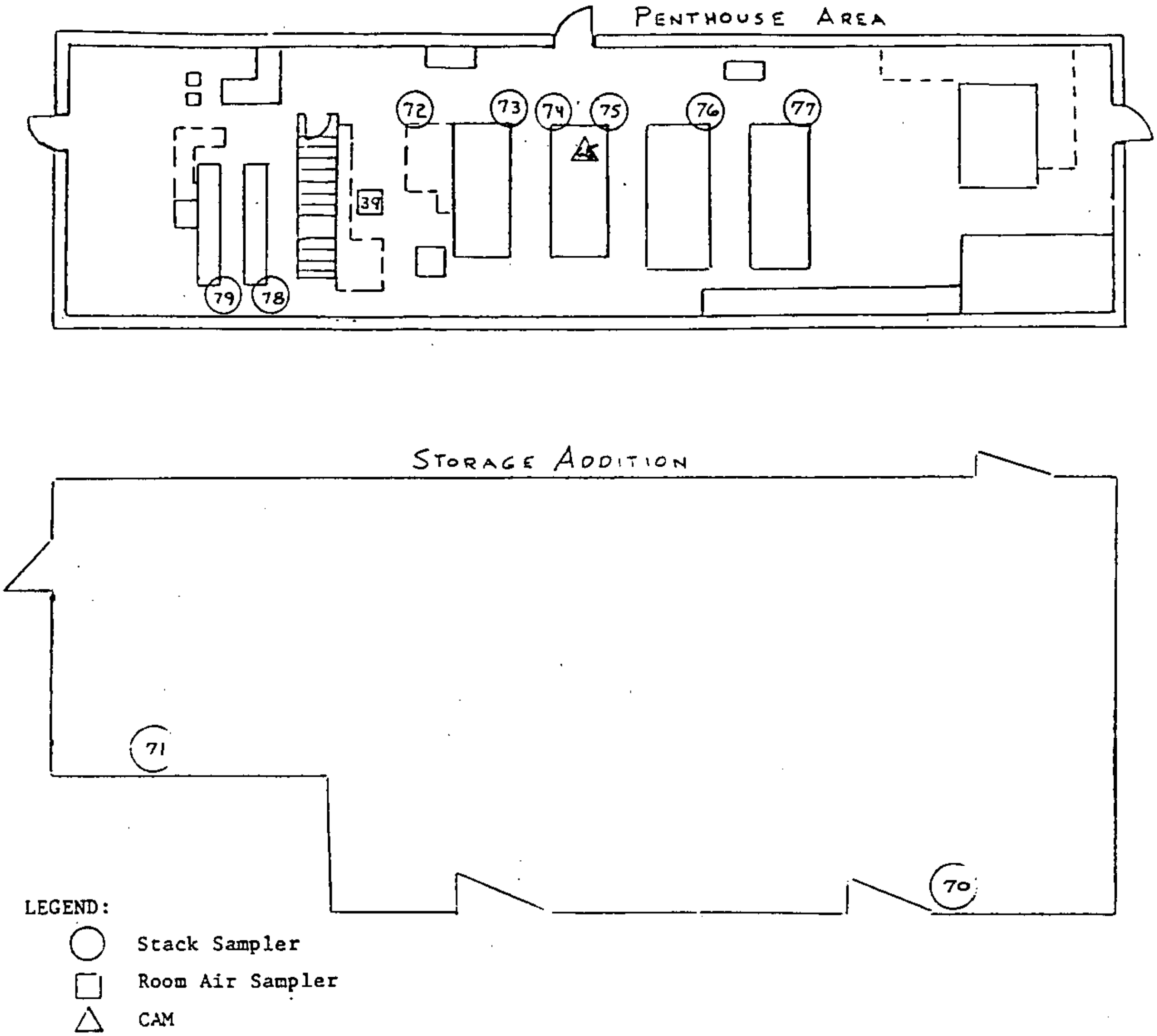


Figure 2-34. Location of PFDL Stack Air Sampling Stations in Penthouse, October 26, 1981

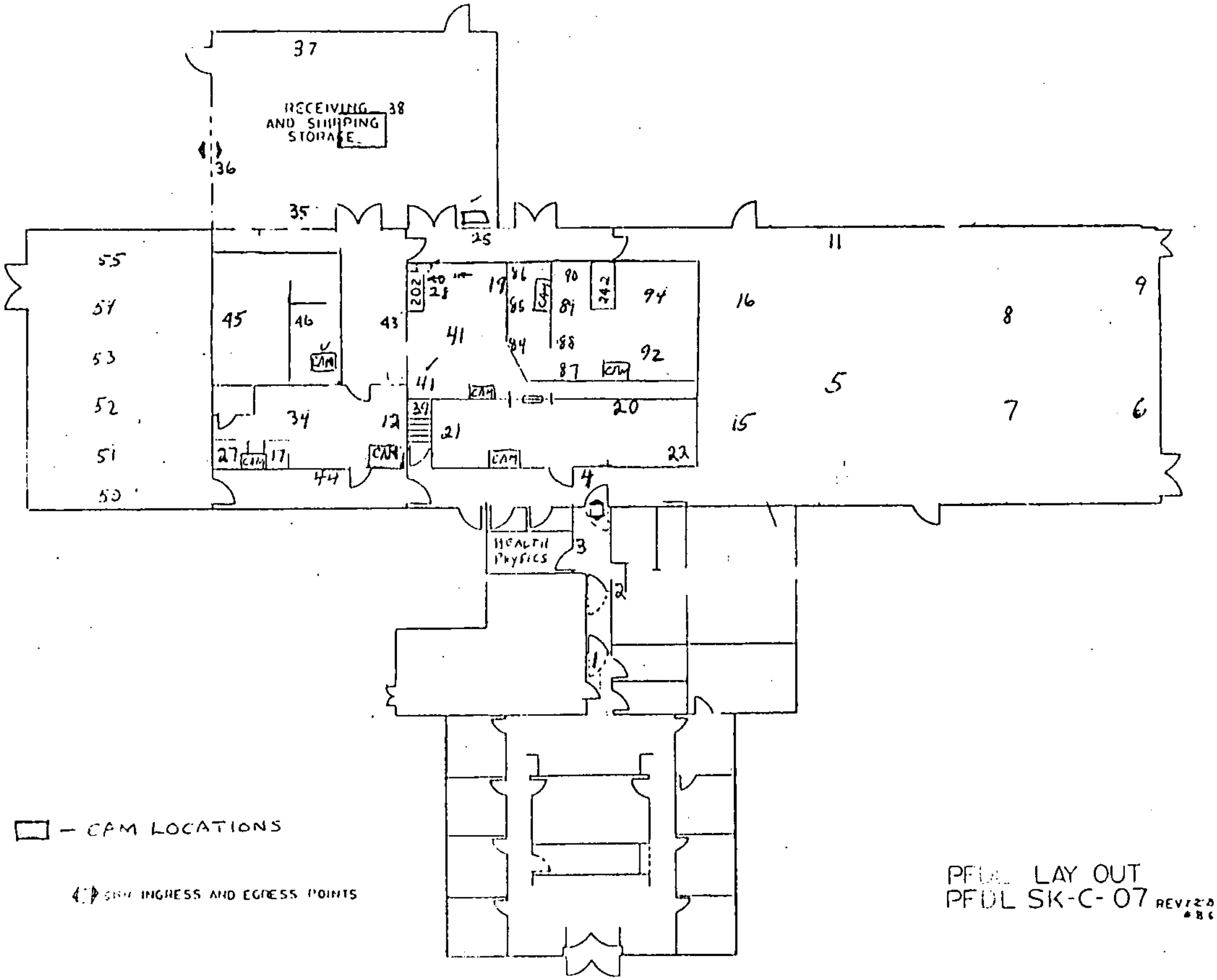


Figure 2-35. PFDL Room Air Sampling Locations, March 31, 1983

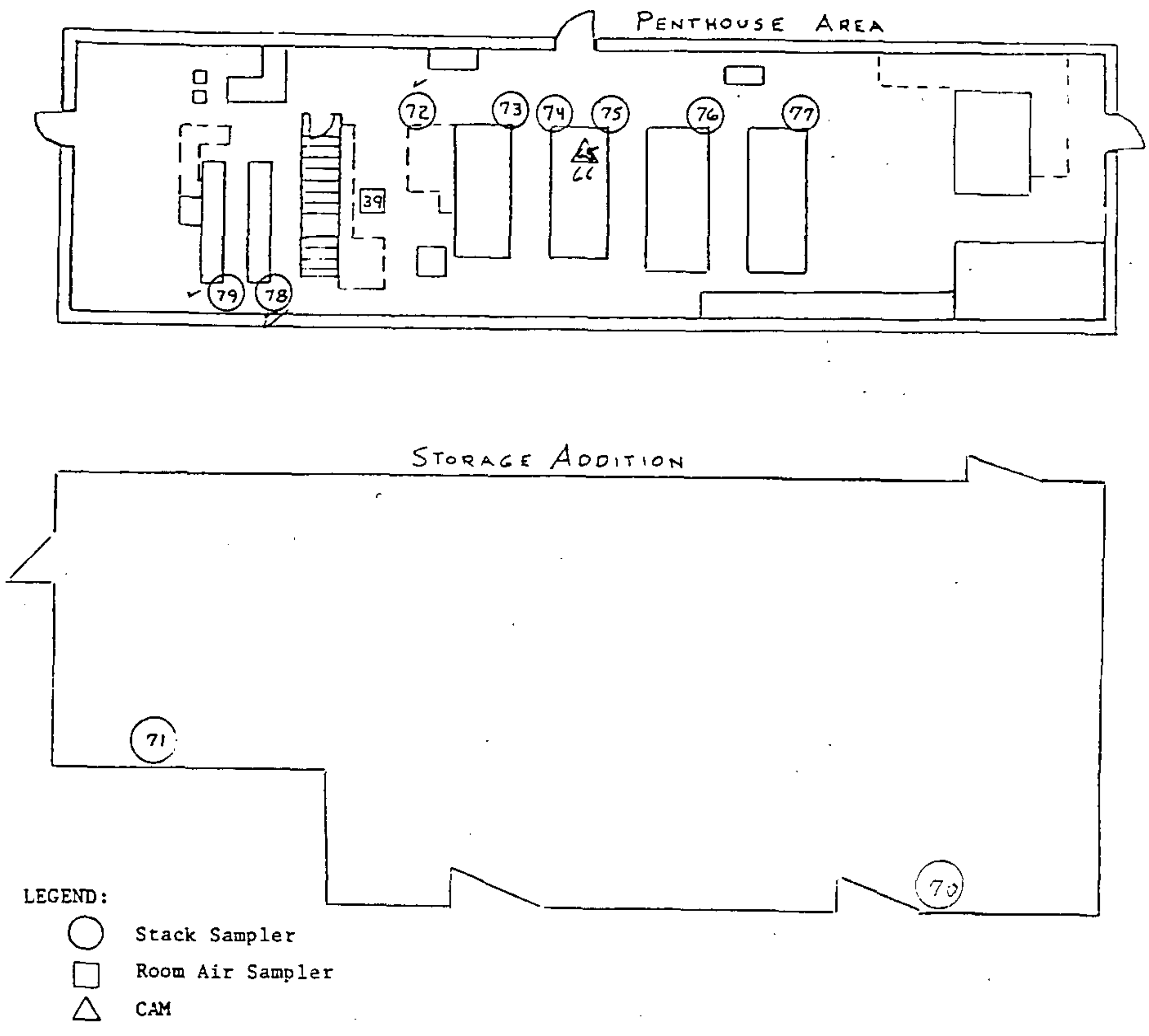


Figure 2-36. Location of PFDL Stack and Room Air Sampling Stations, in Penthouse, March 31, 1983

The personnel exposures recorded on the body badges were used as the basic whole body exposure record. In the event badges were damaged or erroneously exposed, data from pocket dosimeters or radiation surveys were evaluated by the Supervisor of Industrial Hygiene to establish and record the exposure. Wrist or finger badges were provided, and were used for measuring extremity exposures, e.g., hands, if the type of work was such that hand exposures might be significantly greater than the whole body exposure.

The need for body badges was determined by the Supervisor of Industrial Hygiene and this need complied with regulatory requirements. The following factors were used by Industrial Hygiene to determine who would and who would not wear body badges and/or extremity badges:

- The type and quantity of radioactive material
- Radiation surveys
- Evaluation of body badge data

Body badges were normally worn between the waist and shoulders, near the most radiosensitive organs, but never on the belt. They were worn on the outer garments, except when specified otherwise by Industrial Hygiene. If the possibility of contamination existed, the badge was enclosed in a thin plastic bag.

Body badge results were recorded and are part of Industrial Hygiene records. Personnel exposure to external sources of beta/gamma radiation at PFDL were monitored by thermoluminescent dosimeter (TLD) badges worn by individuals. These badges were changed once per month for most of the technicians and once per quarter for other personnel. The criteria for frequency of change was based on the potential for the exposure level to approach the quarterly limit. These TLDs were evaluated by an outside vendor (Eberline Instrument Corporation).

2.14.4.2 <u>Pocket Dosimeters</u> -- Visitors to posted radiation areas or any area where potential radiation exposure existed were provided with pocket dosimeters. Both self-reading and remote-reading pocket dosimeters, e.g., 0-200 mr, were available for use in personnel monitoring. They provided an indication of significant exposures without waiting for the processing of body badges. One or possibly two pocket dosimeters (or "pencils") of the remote-reading type were worn with the body badge when deemed necessary by Industrial Hygiene. They were read normally at the end of each day, but could be read sooner, e.g, following a potential high exposure.

Self-reading dosimeters were worn with the body badge by all individuals on operations where exposure rates were such that exposures of ~100 mr could occur in a day or less. They could be read occasionally by the individual to detect significant increases in their exposure. If a reading of 150 mr or more occurred, Industrial Hygiene was notified so that the reading could be recorded and the dosimeter reset to zero. They were normally read daily and then reset to zero.

Remote reading dosimeters were read daily and reset to zero by Industrial Hygiene personnel.

2.14.5 Personnel Exposure History

2.14.5.1 External Radiation Exposure -- Tables 2-10 and 2-11 provide a breakdown of the exposure history for the PFDL facility over the past five years.

Table 2-10 shows the distribution of radiation exposure of all personnel in terms of percent of personnel in each dose rate range for the years 1978 through 1982*. For comparison purposes, similar information is shown for personnel in all United States fuel fabrication and processing facilities. Reviewing this table shows that the distribution of exposures under License SNM-1120 (PFDL operations) has been on a trend towards the lower exposure ranges over the past five years. The distribution in 1982 has several

*Comparable values for 1983 are not available at this time. However, these values will be included in the 1983 ALARA program report which will be completed and released prior to 9/30/84.

TABLE 2-10

COMPARISON OF PFDL PERSONNEL RADIATION EXPOSURE HISTORY WITH
ALL USA FUEL FABRICATION FACILITIES

Exposure Range (rem)	All Fuel Processing and Fabrication Facilities % of Total					SNM-1120 Operations % of Total					
	1977	1978	1979	1980	1981	1977	1978	1979	1980	1981	1982
<Measurable	39	46	46	42.2	43.7	52.7	45.9	52.4	57.4	55.8	71.6
<0.10	39	31	29	36.6	36.2	11.8	28.8	25.2	25.5	27.3	13.4
0.10-0.25	9	10	12	10.6	11.5	11.8	10.8	6.8	11.7	9.1	7.5
0.25-0.50	5	6	7	5.0	4.9	9.09	8.1	5.8	4.3	5.2	6.0
0.50-0.75	3	3	3	2.5	2.2	3.64	2.7	5.8	1.1	2.6	1.5
0.75-1.0	2	2	2	1.6	0.8	4.55	0.9	1.0	-	-	-
1-2	2	2	1	1.3	0.6	6.36	2.7	2.9	-	-	-
2-3	1	2	0.3	0.1	0.1	-	-	-	-	-	-
3-4	0.2	2	0.05	-	-	-	-	-	-	-	-
4-5	0.2	-	-	-	-	-	-	-	-	-	-
5-6	-	-	-	-	-	-	-	-	-	-	-
6-7	-	-	-	-	-	-	-	-	-	-	-
7-8	-	-	-	-	-	-	-	-	-	-	-
8-9											
9-10											
10-11											
- -											

TABLE 2-11

EXTERNAL RADIATION EXPOSURE FOR OPERATING PERSONNEL AT PFDL FOR A FIVE YEAR PERIOD, 1978 THROUGH 1982

Exposure Range (Rem)	Management, Professional, and Secretarial					Technicians					Analytical Technicians					Maintenance					Health Physics, Security, and Medical					Total				
	78	79	80	81	82	78	79	80	81	82	78	79	80	81	82	78	79	80	81	82	78	79	80	81	82	78	79	80	81	82
<Measurable	20	20	20	19	13	1	6	0	2	9	0	0	0	1	2	5	6	7	6	7	25	22	27	15	17	51	54	54	43	48
<0.10	11	9	9	3	1	9	1	5	6	4	0	0	2	1	0	7	8	6	3	1	5	8	2	8	3	32	26	24	21	9
0.10-0.25	2	3	0	0	0	3	0	8	6	2	2	3	2	1	2	3	0	0	0	0	2	1	1	0	1	12	7	11	7	5
0.25-0.50	1	0	0	0	0	6	6	4	3	4	2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	9	6	4	4	4
0.50-0.75	0	0	0	0	0	2	5	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	3	6	1	2	1
0.75-1.00	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0
1.00-2.00	0	0	0	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	3	0	0	0
2.00-3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Man-Rems	1.2	0.7	0.4	0.1	0.1	8.9	9.8	3.2	3.0	2.4	1.6	1.2	0.5	0.2	0.3	0.8	0.3	0.2	0.1	0.1	0.4	0.5	0.3	0.9	0.4	13	12	5	4	3.3
Number of Persons	34	32	29	22	14	25	22	18	18	20	5	4	4	3	4	15	14	13	9	8	32	31	30	25	21	111	103	94	77	67

important differences compared to the overall industry for 1981 (which are the latest data available). For example, there were no exposures greater than 0.75 rem for License SNM-1120 operations, whereas 0.8 percent of the persons exposed in the industry as a whole were over 0.75 rem; the License SNM-1120 operations showed about 28 percent more personnel in the less-than-measurable category.

Table 2-11 provides the same information but broken down in greater detail by job function, year, and exposure range. To be able to apply this information, it is important to recognize the variations in workload that have occurred since 1978 for the laboratory.

The most significant way to review the detailed breakdown in Table 2-11 is to focus on the total exposure in units of man-rems (see Table 2-11, next to bottom row).

Table 2-12 summarizes this same information as a percentage of the total man-rems for each grouping of personnel. Considering Table 2-12, it is clear that the laboratory and analytical technicians accounted for 70 to 80 percent of the total exposure for the operations. This group in 1982 constituted 30 percent of the total work force, whereas for previous years it constituted 20 percent of the work force. The man-rem exposures for the technicians were approximately 9, 10, 3, 3, and 2 man-rems for the years 1978, 1980, 1981, and 1982, respectively. During 1982, the total exposure was 30 percent lower than in 1981 and 1/4 of the total exposure for 1978. The large reduction in the total exposure level for 1981-1982 versus 1978 was due in part to the lower concentration of plutonium in waste versus the relatively high concentration of plutonium in fuel materials, reduction in the number of personnel, and the large reduction in plutonium inventory.

The man-rem exposure for health physics technicians, which had stayed relatively constant, at about 0.4 man-rem over the years 1978 through 1980, increased to a value of 0.9 man-rem in 1981. However, in 1982, the man-rem value decreased to the 0.4 man-rem level.

TABLE 2-12

PFDL MAN-REM RADIATION EXPOSURE BY JOB FUNCTIONS
FOR A FIVE YEAR PERIOD, 1978 THROUGH 1982

	Percent of Total Man-Rem				
	1978	1979	1980	1981	1982
Management, Professional, Secretarial	9	6	8	2	3
Laboratory Technicians	69	78	70	70	73
Analytical Technicians	12	10	11	5	9
Maintenance	6	3	5	2	3
Health Physics, Security, Medical	3	4	6	21	12

The total man-rems for all of License SNM-1120 operations is summarized in Table 2-13 along with comparative data for the total industry. These data show a significant incremental reduction in external exposure of 77 percent at the Westinghouse Cheswick Site between the years 1978 and 1982; total man-rem exposures ranged from 13 man-rems in 1978 to 3.3 man-rems in 1981.

During 1980 and 1981, the average exposure to an individual under License SNM-1120 operations was about half of that for the overall industry. In 1982, the average incremental occupational exposure to all personnel involved in License SNM-1120 operations was 50 mrem, which is less than half of what could be considered the background radiation exposure for the area. If only those persons who received a measurable exposure are included, then the average incremental exposure to those persons in 1982 was 170 mrem, which is only slightly larger than background radiation exposure but approximately 30 percent greater than for the previous year, and about the same as the industry for the last year of record (1981).

2.14.5.2 <u>Internal Radiation Exposure</u> -- The potential for exposure to internal sources of radiation was monitored primarily by an air sampling program within the facility. Bioassay samples were taken as needed as an independent verification of program effectiveness (see Section 2.14.5.3).

Historical data on the number of daily air samples for which the airborne alpha concentration exceeded the action levels are summarized in Table 2-14. This table lists information on both the number of air sample investigations conducted and the number of individual air samples involved. The bottom row of information summarizes the percentage of the total number of air samples taken in each area which were greater than the action level.

Some samples which were greater than the action level (which triggers the air sample investigation) did not exceed the appropriate MPC for each area. Table 2-15 summarizes the data for only those samples which were greater than MPC for each laboratory area. Again, the bottom row of information shows what percentage of the total number of air samples taken in each area was greater

TABLE 2-13

COMPARISON OF PFDL PERSONNEL RADIATON EXPOSURE HISTORY WITH ALL USA FUEL FABRICATION FACILITIES

Category	Year	Number Facilities	Number of Individuals Monitored	Total Number of Man-Rems	Average Number of Man-Rems Per Facility	Average Exposure Per Individual, Rem	
						All Exposures	Measurable Exposures
Fuel Processing and Fabrication	1977	20	11,496	1,725	86	0.15	0.25
	1978	20	11,305	1,525	76	0.14	0.26
	1979	21	9,946	1,268	60	0.13	0.24
	1980	18	10,204	1,111	62	0.11	0.19
	1981	18	10,552	940	52	0.09	0.16
SNM-1120	1978	1*	111	13	13	0.12	0.22
	1979	1*	103	12	12	0.12	0.25
	1980	1*	94	5	5	0.05	0.13
	1981	1*	77	4	4	0.05	0.13
	1982	1*	67	3	3	0.05	0.17

*Includes all SNM-1120 operations.

TABLE 2-14

SUMMARY OF AIR SAMPLES WHICH EXCEEDED THE ACTION LEVEL FOR PFDL OPERATIONS

	Number of Daily Room Air Samples >Action Level										
	Building 7		Building 8							Total	
Year	ARD Pu Lab	U Lab	North Lab and Addition	Ceramics Lab	Chemical Development Lab	Analytical Lab	ARD Lab	Wet Oxide Lab	Penthouse and Clean Areas	Total Number* of Air Samples >Action Level	Total Number* of Air Sample Investigations Conducted
1978	8	5	0	2	3	13	6	0	0	37	23
1979	2	8	2	6	0	3	3	5	0	29	22
1980	0	3	2	1	0	13	7	4	0	30	22
1981	1(0)†	0	0	3	1	28(3)†	0	7	2	42(16)†	25(13)†
1982	-	0	12(4)	5(0)**	4(1)**	477(5)†	1(0)**	26(8)†	2(1)**	527(19)†	133(13)†
1982 % of Total Samples Taken in Area	0%	0%	0.40(0.13)%**	0.29(0)%**	0.53(0.13)%	12.7(0.13)%	0.07(0)%	1.7(0.05)%	0.10(0.05)%	3.8(0.14)%	

*Since some air sample investigations issued cover the results of several individual air samples, the number of investigations conducted is less than the number of air samples.

**Value in parentheses indicates number of air samples where exposures to plutonium or uranium could have occurred without protection by respirator.

†Values in parentheses delete all cases where tented structures and/or respirators were utilized since these were planned operations and as such take advantage of full-face respirators with a minimum protection factor of 50. Values not in parentheses include all air samples >action level.

TABLE 2-15

SUMMARY OF AIR SAMPLES WHICH EXCEEDED THE MAXIMUM PERMISSIBLE CONCENTRATION FOR PFDL

	Number of Daily Room Air Samples >MPC												
	Bldg. 7		Building 8							Total			
Year	ARD Pu Lab	U Lab	North Lab and Addition	Ceramics Lab	Chemical Development Lab	Analytical Lab	ARD Lab	Wet Oxide Lab	Penthouse and Clean Areas	All Samples in Labs	Distribution (XMPC)	*	**
1978	1	3	0	0	1	11	0	0	0	16	1X-7 4X-1 2X-5 5X-1 3X-2	32	0.2%
1979	0	4	0	1	0	2	0	4	0	11	1X-8 2X-3	14	0.07%
1980	0	1	0	0	0	10	5	4	0	20	1X-5 5X-1 2X-5 6X-2 3X-3 8X-1 4X-2 15X-1	72	0.3%
1981	1 (0)†	0	0	2	0	19 (0)†	0	4	0	26 (6)†	1X-6(2) 10X-1(1) 2X-10(2) 21X-1(0) 3X-1(0) 26X-1(0) 5X-2(0) 31X-1(0) 8X-3(1)	151 (26)	0.75% (0.14%)
1982	0††	0	1 (0)***	1 (0)***	2 (0)***	390 (2)†	0	16 (7)***	2 (1)***	412 (10)†	1X-(4)† 4X-(1) 2X-(3) 5X-(1) 3X-(1)	(23)†	(0.16%)
1982 % of Sample Taken In Area	-	0%	0.03% (0%)	0.06% (0%)	0.27% (0%)	10.4% (0.05%)	0%	1.3% (0.56%)	0.13% (0.07%)	2.9% (0.07%)			

*Figure of Merit: Equivalent number of sample-days at MPC.

**Figure of Merit: Percent of possible number of sample-days at MPC

***Values in parentheses indicate number of air samples where exposures to plutonium or uranium could have occurred without protection by respirators.

†Values in parentheses delete all cases where tented structures and respirators were utilized since these were planned operations and as such take advantage of full-face respirators with a protection factor of 50. Values not in parentheses include all air samples >MPC.

††The ARD Plutonium Lab in Bldg. 7 was completely decommssioned in 10/81, and was removed from the license in 1/82. No air sampling was performed after 11/81.

than MPC. It is also important to consider how much above MPC the individual samples were. This distribution is presented in the third column from the right-hand side of Table 2-15, which shows the number of samples that were one times MPC, two times MPC, etc. The last two columns of the table provide a figure-of-merit value which is a weighted distribution to account for the magnitude of the individual samples.

For 1981 and 1982, additional information is provided beyond that presented in years prior to 1981. During 1981, operations were planned where airborne activity was expected to be above MPC for a considerable period of time and thus full-face respirators with a protection factor of 50 were provided. At the beginning of 1982, a tented glove box dismantling facility was set up in the Analytical Laboratory area. Full-face respirators with supplied air providing a protection factor of 2,000 were required while working in this area. A special health and safety procedure was written and training was given for those working in this operation (see Appendix E). Other potentially hazardous operations (e.g., removal of liquid transfer piping in the wet oxide area) were performed using full-face, air-purifying respirators with a protection factor of 50. Since these operations were conducted entirely in protective clothing and full-face respirators, the measured air concentration values given do not represent the actual potential for internal exposure. Thus, all operations not involving full-face respirators have been shown separately in these tables by the numbers given in parentheses on the basis that internal exposures in cases where respirators are worn would be negligible in comparison to the exposures which could occur if respirators were not used.

Based on these considerations, internal exposures greater than action level actually were about the same in 1982 as in 1981 based on the value in parentheses in the last column of Table 2-14, which represents the number of air samples where significant exposures to uranium or plutonium could have occurred without protection by respirator. The number of exposures to greater than MPC levels also was about the same in 1982 as in 1981 based on the figure-of-merit values given in the last two columns in Table 2-15. Only significant exposures have been summarized for 1982 in the distribution and figure-of-merit columns since there were so many air sample values within the sectioning area which were reported in air investigative reports but were not a significant contributor to internal exposures because of respiratory protection. Such increases are a result of dismantling, decontaminating, and packaging operations which are necessary for decommissioning the facility.

The data provided in Tables 2-14 and 2-15 are not sufficient to make an estimate of personnel exposure. Since the majority of the room air samples measured fall below the minimum detectable activity (MDA), the estimate for exposure must be based on the assumption that all samples $\leq$MDA were at the MDA concentration. Of all these samples, 40 percent are for transportable plutonium with the MDA at 5.5 percent of MPC; the remaining 60 percent are for nontransportable plutonium with the MDA at 0.3 percent of MPC. The weighted average for the increment of samples which are $\leq$MDA would provide an average exposure estimate of 2.4 percent of MPC. Added to this increment would be those samples between the action level and MPC. For 1982, this adds about 0.1 percent of MPC. An additional increment includes the samples which are greater than MPC. Using the figure-of-merit data in Table 2-15 for the 1982 average adds 0.2 percent of MPC. There would also be an increment of dose for air samples which fall between the MDA and the action level which has not been taken into account. This very small number of samples is probably of the same order of magnitude as the number of samples greater than action level. Thus, the total for these increments is approximately 2.9 percent of MPC for 1982. This value is the same as for 1981 and compares with 3.0 percent for 1980 and 6 percent of MPC for the average of the three previous years. This represents a maximum exposure estimate since 80 percent of the estimate is based on the assumption that all air samples that are less than the MDA concentration are taken as being at the MDA concentration.

Although the number of air samples greater than MPC increased about a factor of 12 in 1982 compared with 1981, the effective figure of merit (which is indicative of internal exposure and so includes the effectiveness of using respirators) was evaluated to be about the same as in 1981 and approximately a factor of 2 lower than for 1980. The overall figure of merit for all air samples was the same as for 1980 and 1981 and about 50 percent lower than the average for the previous three years (1977-1979). The lower internal exposures in the last two years are a result of the effective use of respirators in areas where higher than MPC air concentrations are expected.

2.14.5.3 Results of Bioassay and In Vivo Counting --

o 2.14.5.3.1 Bioassay Results -- Bioassay sampling is conducted as an independent means of verification of the effectiveness of the overall health physics program to control personnel exposures to internal deposition of radioactive material. This routine bioassay program (as described in Section 2.14.3) consisted of the quarterly collection of approximately one-liter urine samples from personnel who work within the controlled areas. The results of this sampling program during decommissioning (1979 through 1982) are summarized in Table 2-16. The second column in this table shows the total number of bioassay samples taken for the year. The third column shows the number of samples with measurable activity (i.e., above 0.03 dpm/ℓ for either Pu-238 or Pu-239). The fourth column shows the number of samples which showed activity levels above the "action level." Until the end of October 1981, the action level was defined as 0.2 dpm/liter. After October 1981, Amendment 10 to NRC License SNM-1120 required two different action point levels depending on the previous history of the individual. For persons with previous history of Pu-238 and Pu-239 having been above minimum detectable activity (MDA), an "action level" of 0.2 pCi/day or ~0.44 dpm/liter is required. For persons with no previous history of Pu-238 and Pu-239 being above detectable levels, an "action level" of 0.05 pCi/day or ~0.11 dpm/liter is required. Thus the larger number of personnel showing activity above "action level" in 1982 (three) versus a lower number in 1981 and 1980 (one) is due to the lower threshold action level which was put into effect in November 1981, since most of the personnel at the PFDL had no previous history of Pu-238 and Pu-239 levels above MDA and only one individual would have exceeded action level by the former limit of 0.2. This is further supported by the relatively fewer samples showing measurable activity (eight) versus those for 1981 and 1980 (twelve and nine,

TABLE 2-16

SUMMARY OF URINE BIOASSAY RESULTS DURING PFDL DECOMMISSIONING (1979-1982)

Year	Total Number of Bioassays	Number of Samples Showing Measurable Activity	Number Showing Activity Above* Action Level
1979	262	0	0
1980	281	9	1
1981	176	12	1
1982	202	8	3

*Action level was defined as 0.2 dpm/liter until November, 1981. After November, 1981, the action level was changed by Amendment to License SNM-1120 to 0.11 dpm/liter for persons with no previous history of plutonium above MDL and 0.44 dpm/liter for persons with previous history of plutonium above MDL.

respectively). In summary, these data indicate that only very minimal internal contamination is indicated and this minimal activity appeared to peak in 1981 and then decreased in 1982 when a complete respiratory protection program was implemented.

o 2.14.5.3.2 In Vivo Counting Results -- In vivo counting was also conducted on a selected number of personnel. In vivo counting prior to 1982 was primarily performed by a mobile counting system brought onto the site once a year. The selection of persons to be counted was based on the history of facility operations over the previous year with preference given to those persons who had the highest potential for exposure to airborne activity. Table 2-17 shows a summary of in vivo counting results during decommissioning (1979 through 1982). Column 2 shows the total number of personnel counted. Columns 3 and 4 show the results of in vivo counting for Pu-239 and Am-241, respectively.

None of the individuals counted have shown any measurable Pu-239 activity. However, the number of persons showing measurable activity for Am-241 (a daughter nuclide of Pu-241) showed an apparent rapid increase from 2 in 1979 to 17 in 1981 and then decreased to 3 in 1982. When 17 out of 30 showed measurable activity when counted at the mobile counting facility in 1981, 7 persons with the highest activity were recounted at a fixed counting facility (University of Pittsburgh Low Level Radiation Monitoring [LLRM] facility). When recounted at the LLRM, six of the seven showed less than minimum detectable levels and the seventh showed a barely detectable level of 0.21 $\pm$0.07 nCi while the MDA is 0.13 nCi. The latter measurement was more than a factor of two lower than at the mobile counting unit two months earlier.

It is strongly suspected that some of the other 11 personnel who were counted in the mobile unit also would have shown less than detectable if recounted at the LLRM facility. Hence, it is believed that the mobile counting unit results are not as reliable in showing in situ contamination as a fixed facility such as LLRM. For this reason, in 1982 and 1983, all whole body counting was done at the LLRM facility and none was done on the mobile unit.

TABLE 2-17

SUMMARY OF IN VIVO COUNTING RESULTS DURING PFDL DECOMMISSIONING (1979-1982)

Year	Total Number of Personnel Counted	Number Showing Measurable Activity (Pu-239)	(Am-241)
1979	24	0	2
1980	32	0	11
1981	30	0	17(11)*
1982	36	0	3

*Seven individuals who were reported to have the highest activity were recounted at another facility two months later, and six were found to have less than minimum detectable level. Hence, eleven is believed to be an upper limit value.

Several reasons can be postulated as to why a mobile unit is not as reliable as a fixed facility, but the foremost is that body surface contamination is more easily controlled in a fixed facility since all who are counted are required to take a shower just prior to counting and they are carefully monitored by a hand-held monitor prior to counting, whereas such was not the case with the mobile unit.

If we consider the data per se in Table 2-17, we note an apparent buildup of measurable activity in 1980 and 1981 which effectively decreased in 1982 when a complete respiratory protection program was implemented. There is question whether full reliance can be placed on the data obtained from the mobile unit to show an increase. However, since there was greater potential for exposure to airborne contaminants in 1982, one must give credit to implementation of a respiratory protection program in limiting the exposure of the operators and perhaps causing a reduction. From these data, as well as from the previously reported urine bioassay data, it can be seen that internal exposures were maintained at a very low level and the respiratory protection program which was fully implemented at the beginning of 1982 was effective in reducing in situ activity to even lower, barely detectable levels.

SECTION 3
PROJECT SCHEDULING AND ORGANIZATION

3.1 SCHEDULE

The milestone completion schedule for the decontamination and decommissioning activities is shown in Table 3-1. Activities commenced many months prior to the first milestone completion in January 1982. Prior to 1981, there was some effort involved in removing small easily handled items from glove boxes and removing nonessential facility equipment. In the spring of 1981, work started in the Analytical Laboratory to remove all equipment from glove boxes and fume hoods and to decontaminate glove boxes using a work force of five to eight people. The full work force was not available until mid 1981 at which time the overall effort was begun. In the remainder of 1981, effort by the laboratory technicians was directed toward removing equipment from glove boxes and decontaminating and fixing glove boxes in preparation for sectioning. The sectioning facility was activated in January 1982, and work progressed as shown in the milestone schedule.

3.2 PERSONNEL ORGANIZATION

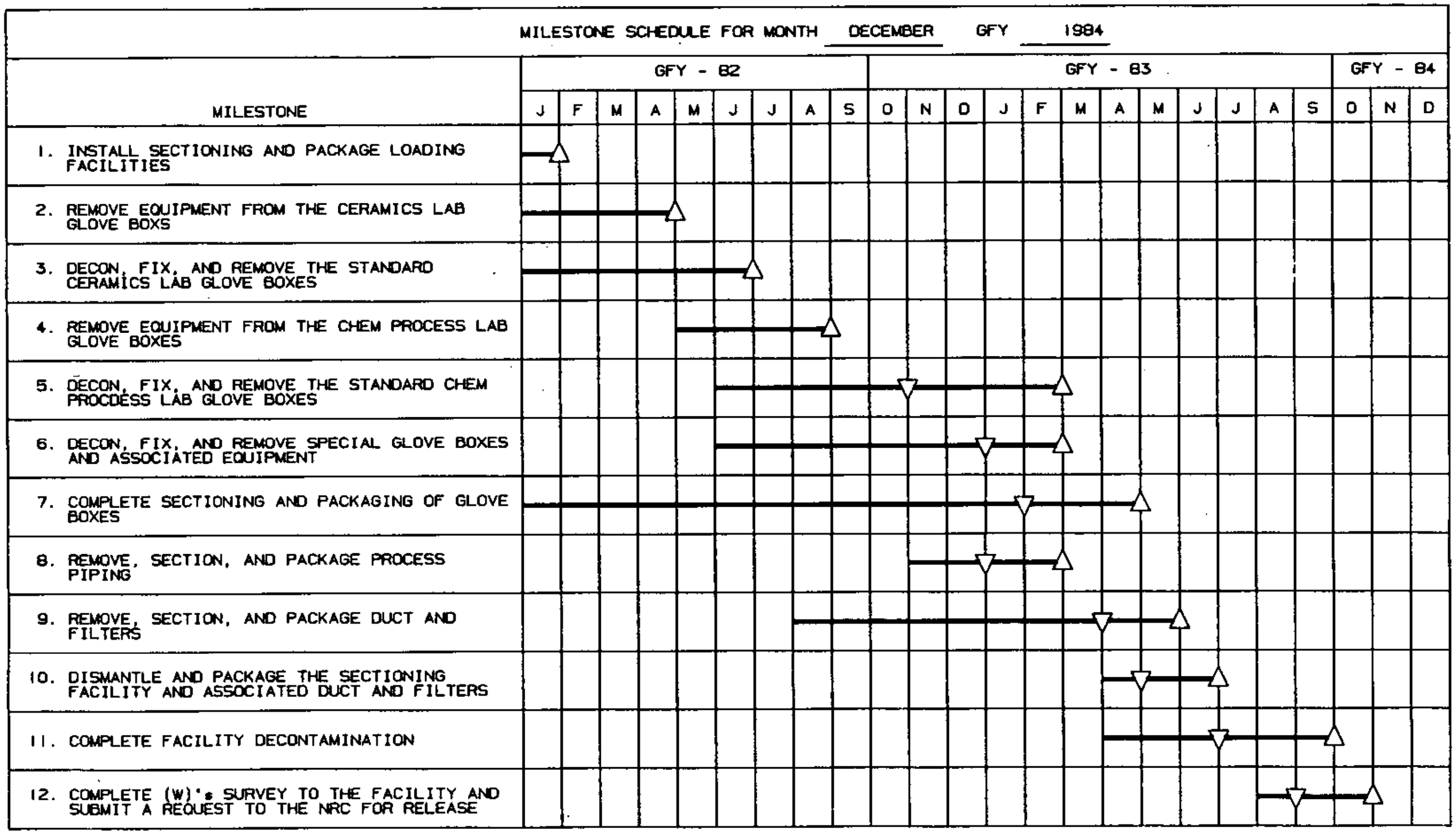
The basic organization structure is shown in Figure 3-1. During the bulk of the work, which covered the period from mid 1981 through the summer of 1983, the sizes and activities of the various operations groups were as follows:

3.2.1 <u>Operating Technicians</u>

The laboratory operating technician staff remained at approximately 20 individuals for most of the period, with a slight decrease due to attrition in the first half of 1983 to approximately 15 individuals by mid 1983. The functional make-up of this force was organized into several very effective groups which provided for a logical continuous flow of operations. One group was always involved with cutting and wrapping of contaminated equipment.

TABLE 3-1

DECONTAMINATION AND DECOMMISSIONING OF PFDL FUEL FACILITY



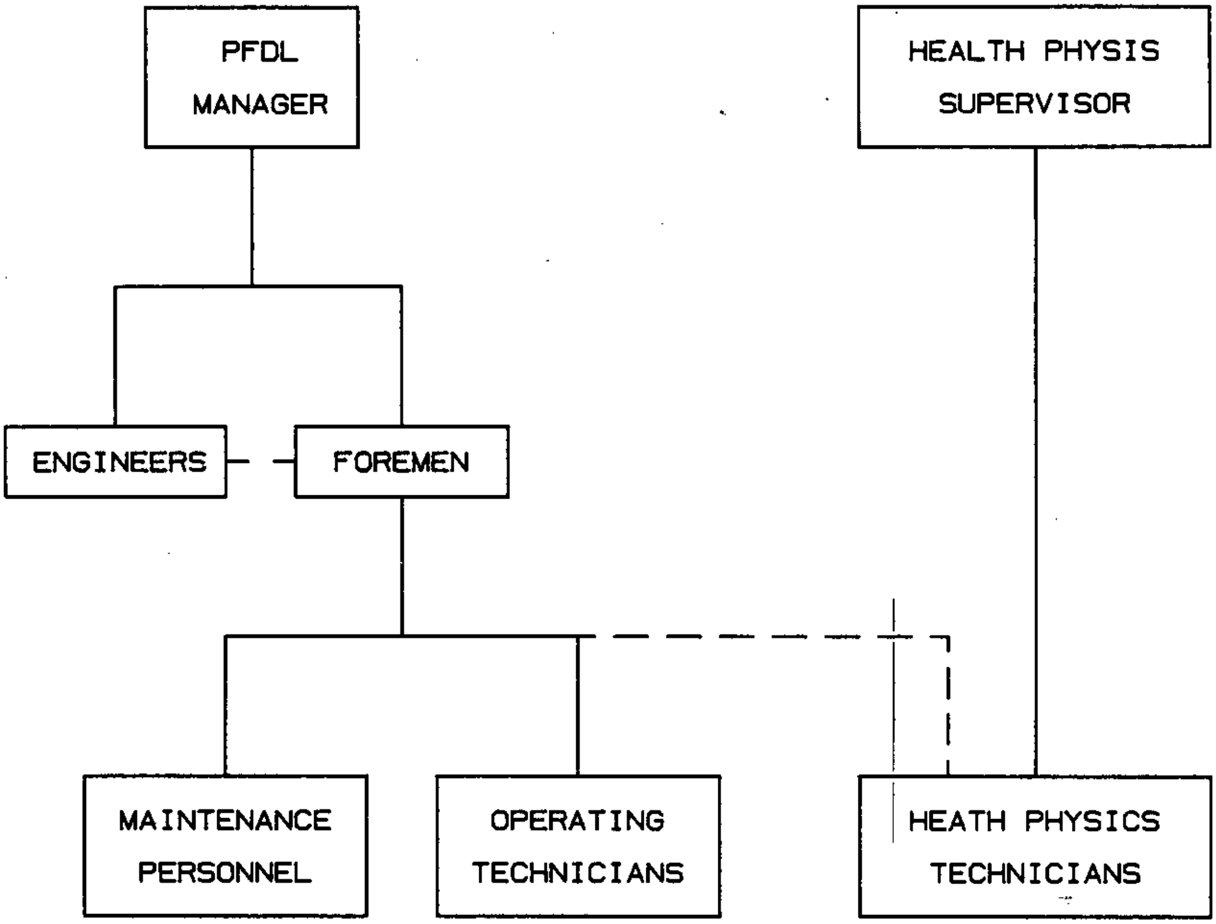
LEGEND:

PROGRESS STATUS

△ COMPLETED MILESTON

▽ ORIGINALLY PLANNED MILESTON, IF DIFFERENT FROM COMPLETED MILESTONE

7828F-2



NOTE:

SOLID LINES INDICATE REPORTING AND FUNCTIONAL RESPONSIBILITIES.

DASHED LINES INDICATE FUNCTIONAL INTERACTION.

Figure 3-1. Decontamination and Decommissioning of PFDL
Fuel Facility -- Organization

Another group packaged equipment into final shipping containers and handled the considerable quantity of paperwork involved. Two or three technicians were constantly busy performing NDA of the packaged scrap. The remaining group size varied with the availability of technicians and was responsible for removing equipment and decontaminating glove box interiors. Also, a group was formed as needed to cut down and remove contaminated pipe, duct, and filter caissons.

After the glove box decontamination and sectioning was complete, the personnel not involved in NDS and packaging were all directed toward facility structure decontamination and dismantling activities.

The optimum makeup of the group performing the glove box sectioning in the special facility for that purpose was two or three operating technicians and one health physics technician. This group was supported by a Health Physics technician who was always in attendance outside the sectioning facility monitoring the CCTV and intercom, and another technician who was a "go for." Groups formed for in situ cutting of contaminated equipment such as pipe and duct were of a similar make-up; they consisted of two or three operating technicians and a Health Physics technician performing the actual cutting operations. One or more back-up technicians were utilized for wrapping, and another technician was assigned outside the area as a "go for." It was found that the most optimum work crew for working directly with contaminated equipment was two or three individuals with one Health Physics technician; more individuals in a group or more than one group in an area resulted in occasional confusion with the potential for safety mishaps.

One quality control inspector was required to perform inspections of shipping containers and packages, and to verify packaging operations.

3.2.2 Health Physics Technicians

Four to six Health Physics technicians were utilized during the equipment and facility decontamination and dismantling effort. Routine facility surveys occupied one technician full time. The two major efforts were surveillance of the contaminated cutting operations and evaluation of hardware, equipment, and materials for release from the facility as uncontaminated items.

3.2.3 Maintenance Personnel

Maintenance personnel consisted of electricians, mechanics, and building and grounds craft workers. These individuals did not work regularly on contaminated materials. Their duties were to install and disconnect mechanical and electrical equipment, install temporary walls, etc., and remove interior structures. A continuing large effort was involved with removing and relocating the various alarm lines as partitions and equipment were removed in order to maintain the operation of all the alarm circuits. The maintenance staff consisted of six to eight people.

3.2.4 Professional Staff

Five engineers were initially involved working part to full time on the planning and development. At the commencement of the main effort in mid 1981, four engineers were involved: nondestructive assay, safeguards/accountability, waste packaging and shipping, and general operations. As the decontamination and dismantling progressed, the NDA effort became routine, and the safeguards/accountability work decreased. The engineering staff was, therefore, decreased to two individuals.

One of the engineers was occupied for most of the decontamination and dismantling effort on matters pertaining to waste handling, packaging, and shipping. The other engineer handled technical direction, planning, and scheduling.

Three foreman were responsible for the technician work force at the start of the main effort: one for maintenance activities, one for operations involving the cutting of exposed contaminated equipment, and one for general laboratory operations. Two of these foremen were transferred to other duties in the fall of 1982, and the one remaining foreman and the two engineers furnished the necessary technician direction and supervision for the remainder of the project.

Technical support for the Health Physics technicians, and planning for the equipment and facility contamination surveys, was performed by a Health Physics supervising engineer on a part-time basis. The daily direction of the Health Physics technicians was the responsibility of the facility operations staff.

SECTION 4
FINAL SITE CONDITION

4.1 PROCEDURES FOR RADIATION SURVEYS

To demonstrate that the Building 8 Plutonium Laboratory met all applicable criteria to be released for unrestricted use, a monitoring program was undertaken to conduct a detailed final survey of the building. A description of the measuring equipment for the radiation surveys is found in Appendix F.

Radiation surveys of the plutonium laboratory room surfaces were performed in several steps based on operating procedures prepared specifically for these surveys. The first procedure (No. PFDL-OP-D-0835) covered the methods used to establish a grid system to uniquely identify areas of the walls, floor, and ceiling to be surveyed. Another procedure (No. PFDL-OP-D-0842) described the requirements of monitoring radioactive contamination in holes or penetrations within the walls, floor, or ceiling. Finally, a procedure (No. PFDL-OP-D-0834) was also written for performing the final survey of wall, ceiling, and floor surfaces. This procedure requires that all surfaces meet the limits of contamination for uncontrolled use according to ANSI N13.12[2] and License SNM-1120 decommissioning criteria and uses a statistical sampling approach to ensure that these criteria are met. The detailed procedures used in the plutonium laboratory radiation surveys are listed in Table 4-1, and these procedures are presented in Appendix B.

Miscellaneous surfaces not covered by the above procedures (that is, ducting, piping, structural supports, electrical equipment, drains, etc.) were surveyed for removable contamination by smears, and for total radiation by beta/gamma survey instruments. These data were recorded on miscellaneous data sheet records with attached sketches of survey locations. To the extent possible, such items were removed from the facility prior to conducting the final survey. Holes were made in the laboratory's internal walls 6 inches below hole areas where measurable contamination was found to determine if there was

TABLE 4-1

LISTING OF APPLICABLE PROCEDURES FOR RADIATION SURVEYS OF PFDL

(See Appendix B for Procedures)

Procedure Number	Title
PFDL-OP-D-0834	Monitoring Requirements for the Wall, Ceiling, and Floor Surfaces of the Plutonium Laboratories for Radioactive Contamination
PFDL-OP-D-0835	Establishment of Surface Grid for Walls, Floors, and Ceilings for Detailed Radiological Survey
PFDL-OP-D-0842	Hole Survey Monitoring Requirements for Determining Radioactive Contamination in Wall, Floor, or Ceiling Penetrations

any contamination between the internal and external walls. Then, these access hole areas were monitored for fixed and removable radioactivity.

Personnel performing or assisting in these surveys were instructed in the procedures and were authorized as qualified by a sign-off sheet acknowledging the individual's understanding and ability to perform the procedure as approved by the Supervisor of Industrial Hygiene.

As recommended in NUREG/CR-2082,[3] proof of compliance with termination criteria is based on a statistical sampling plan. The statistical treatment requires a minimum sample size of 30 measurements for each analysis. In general, the floors, walls, and ceilings were treated as separate items subject to independent sampling programs. Depending on the size of the room, the walls were either considered separately or combined to provide a reasonable area for the sampling program. Figures 4-1 through 4-3 show a plan view of the overall building after removal of the internal walls, the office area, and the office auxiliary area, respectively.

The selection of the grid points to be measured was made on a biased random basis; areas which were suspected to have a high potential for contamination based on a historical review were first selected. The remaining grids were then selected on a purely random basis. The identification of the grid system and the selected grid points are presented in Figures 4-4 through 4-42.

Figures 4-43 and 4-44 show the sample points for the ceiling beams and miscellaneous fixture measurements. Figure 4-45 shows a typical grid layout on a wall. A summary of the type of measurements made at PFDL is provided in Table 4-2.

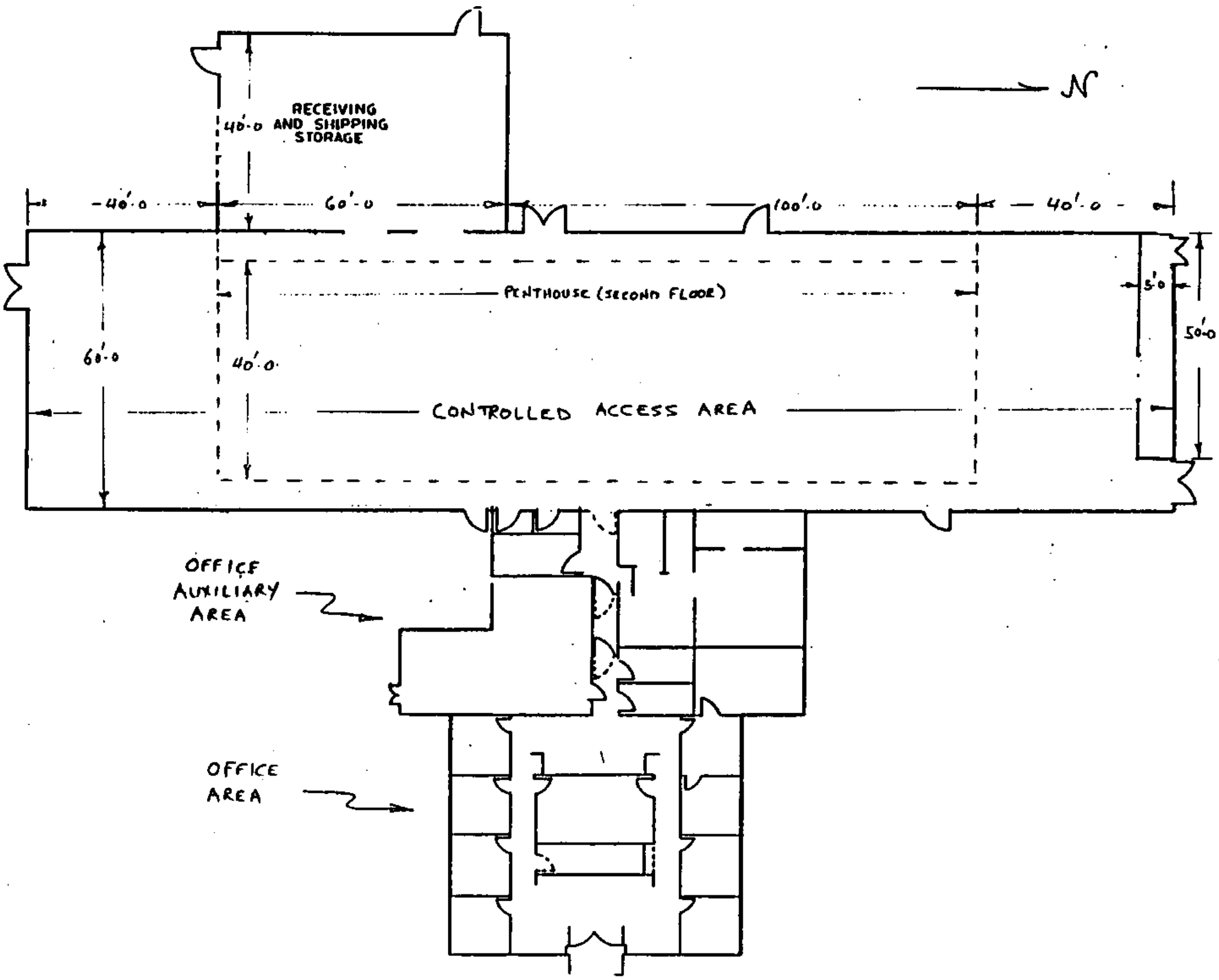


Figure 4-1. PFDL, Building 8, After Removal of Laboratory Internal Walls

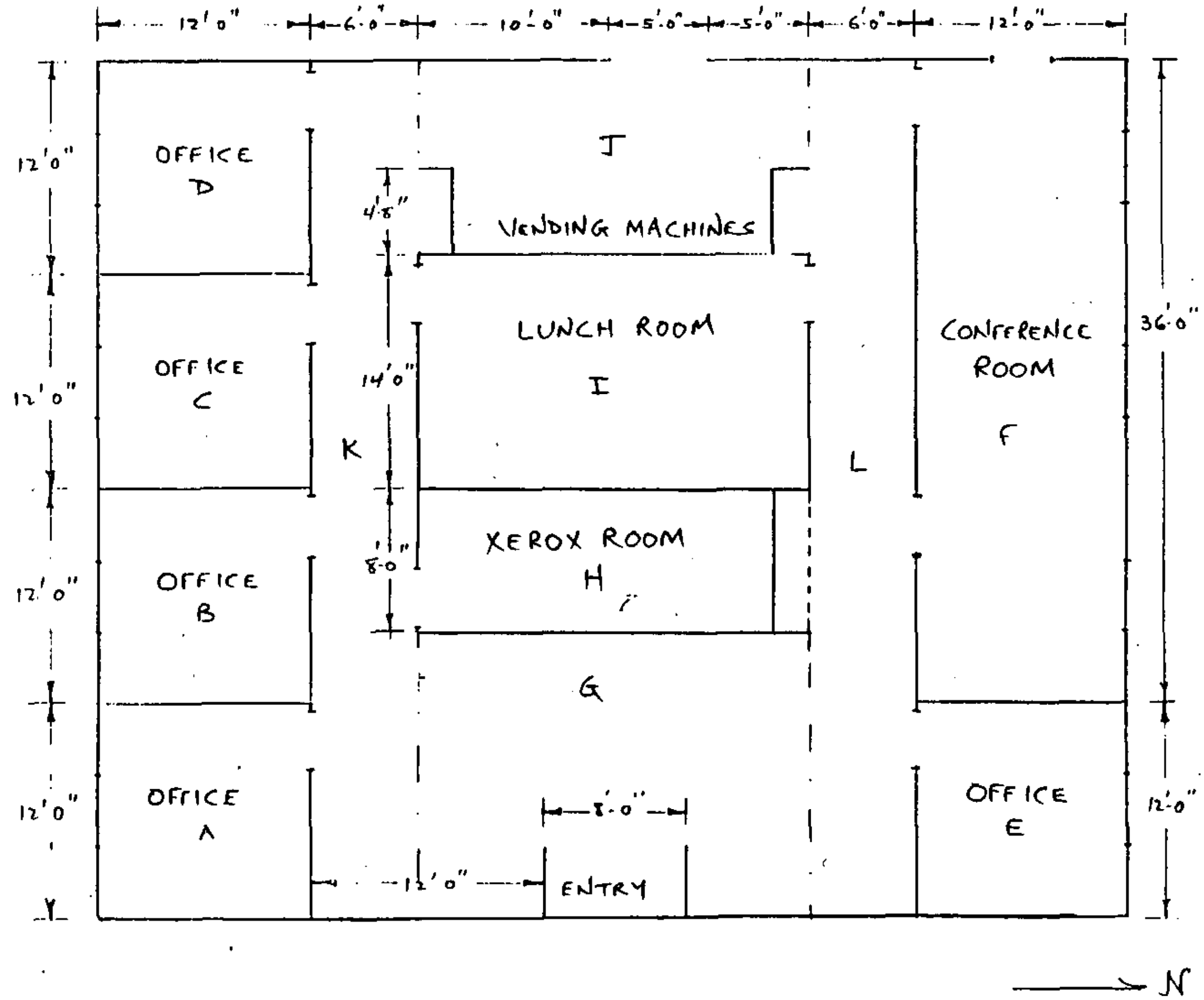


Figure 4-2. PFDL Office Area Showing Location of Interior Walls

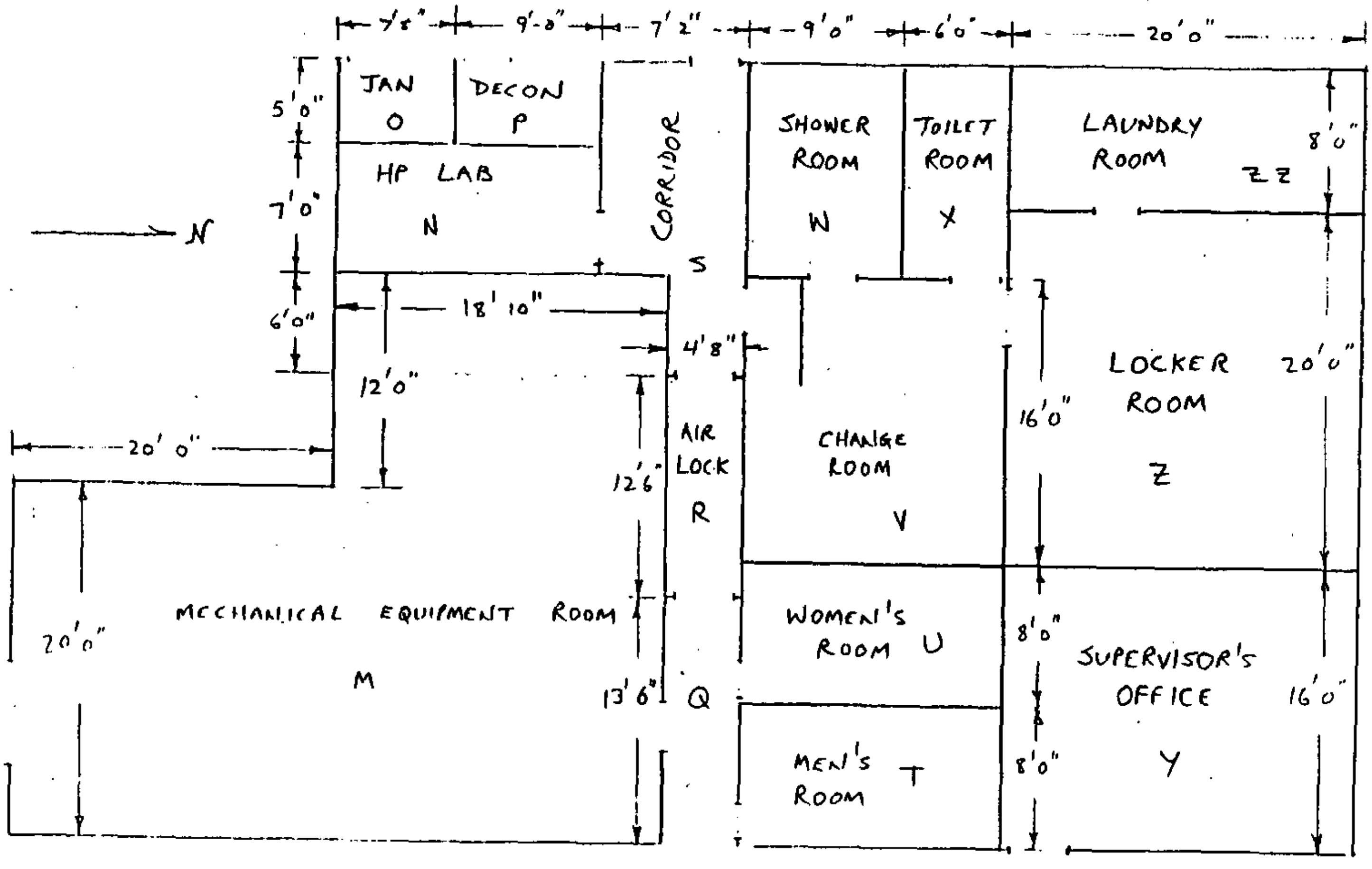


Figure 4-3. PFDL Office Auxiliary Area Showing Location of Interior Walls

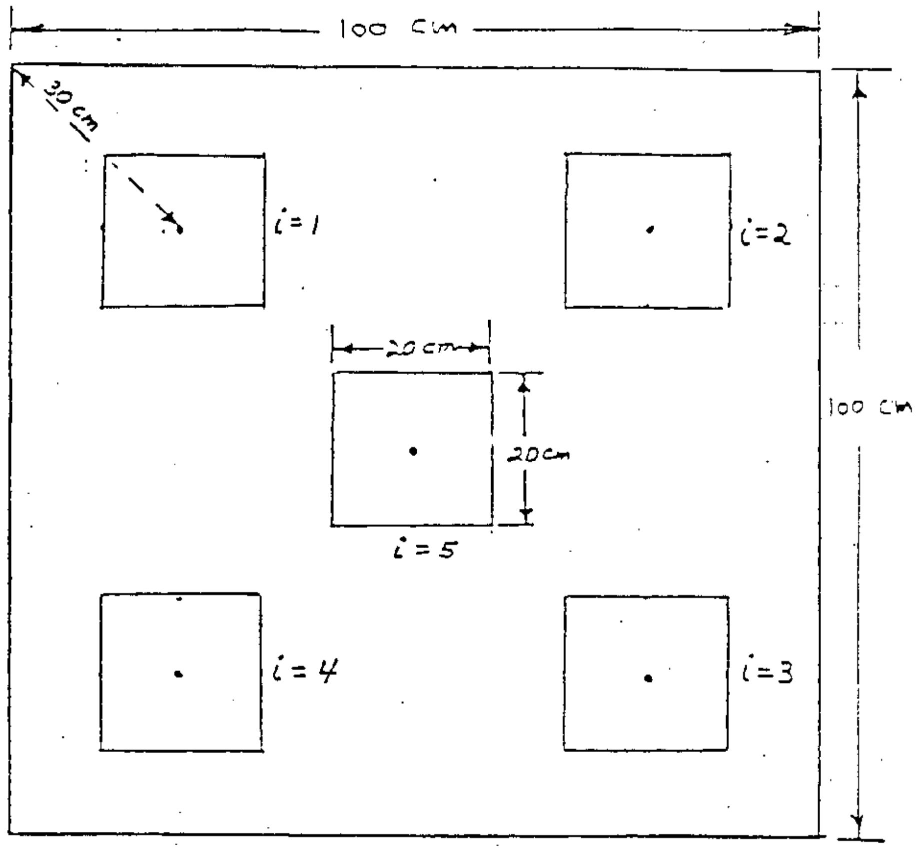
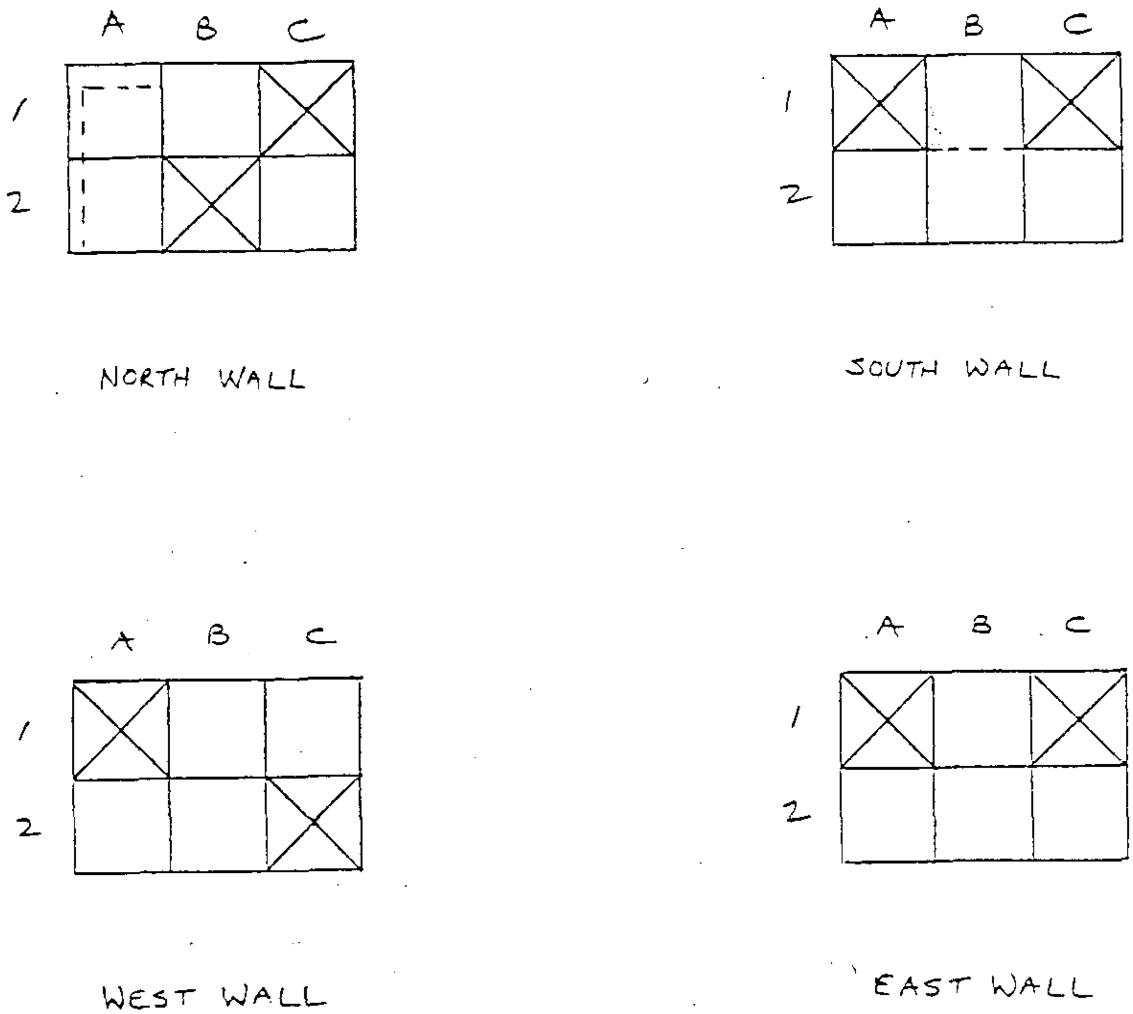


Figure 4-4. Typical Grid Layout Showing Location of Survey Sampling Points Within The Grid



Each square represents a 4'x4' area. A 1m x 1m area within the 4'x4' area was selected for survey in the office area and office auxiliary area.

Figure 4-5. Survey Grid Locations, Building 8 Office A

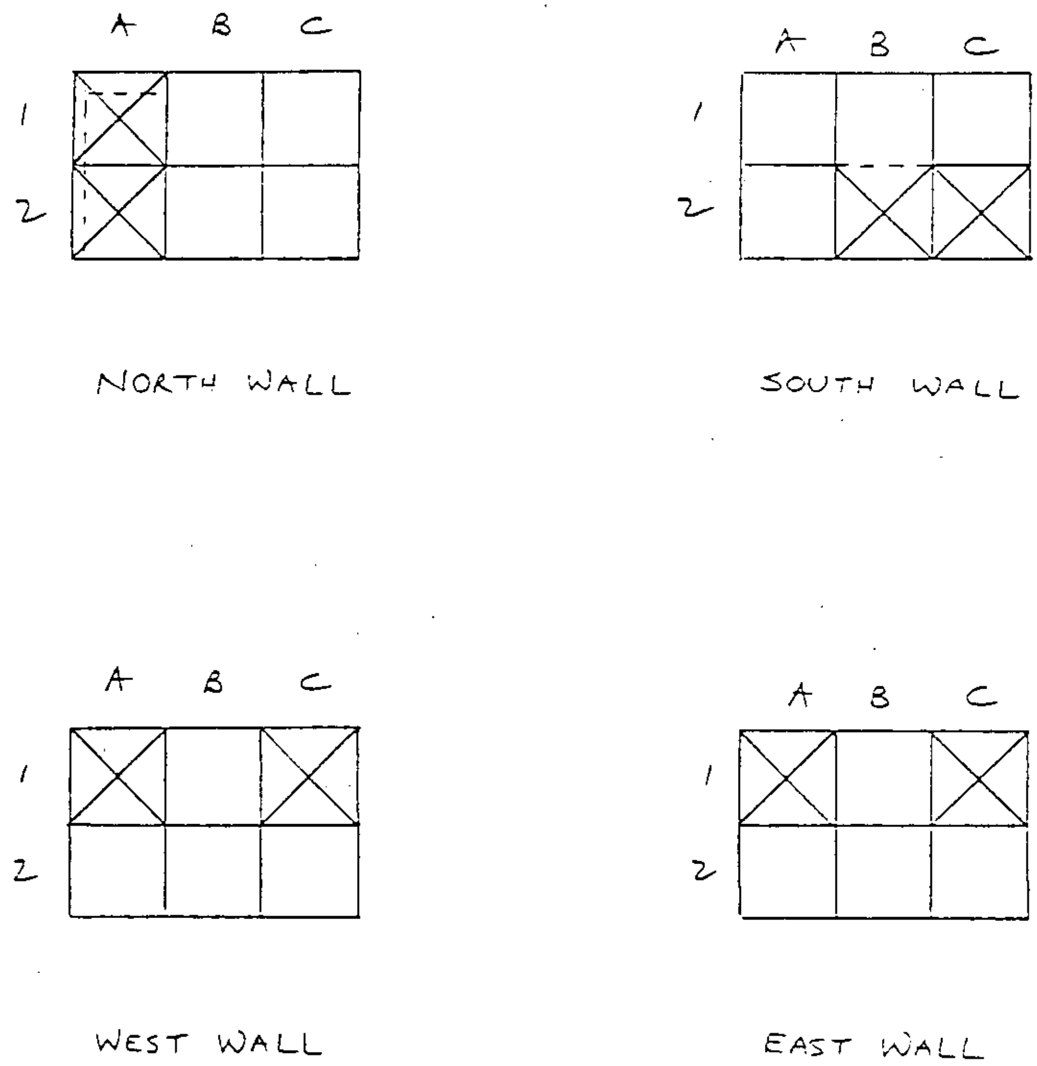


Figure 4-6. Survey Grid Locations, Building 8 Office B

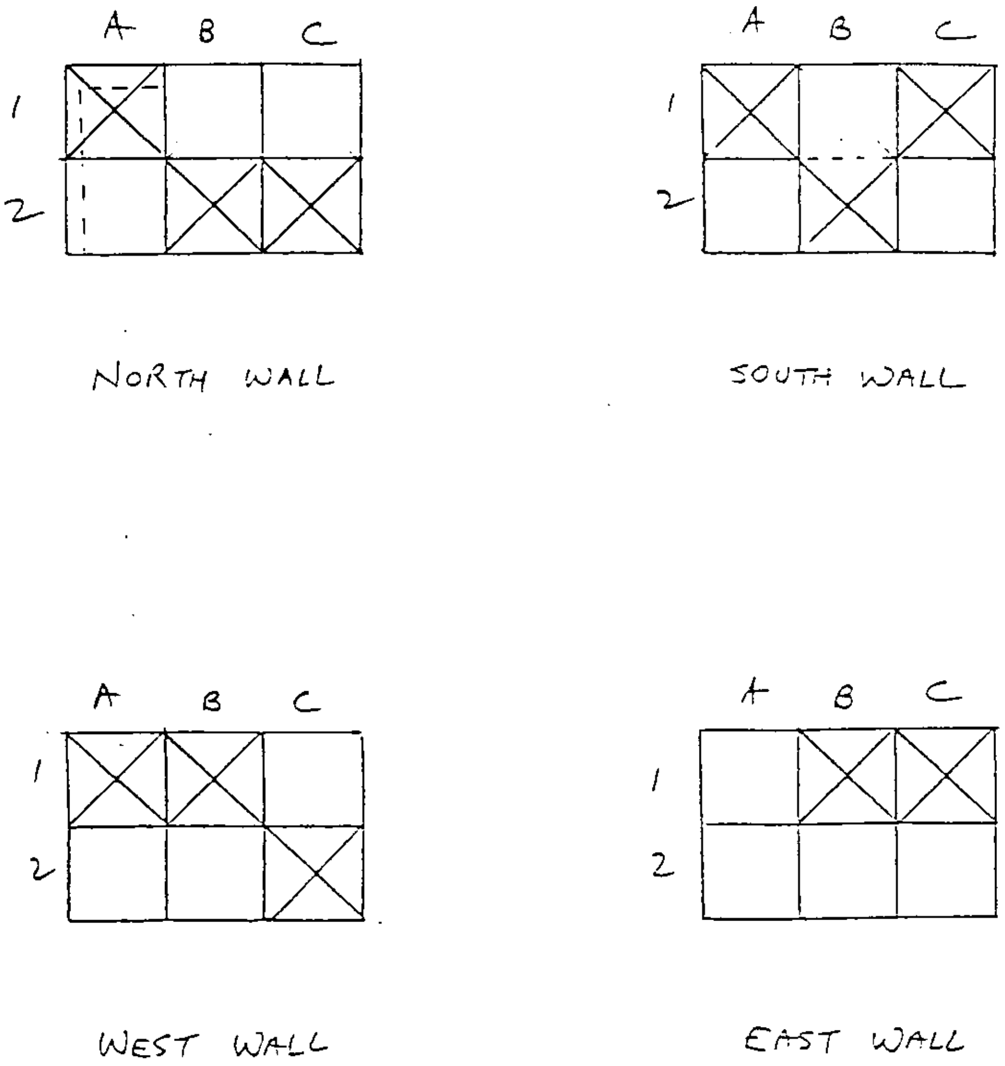


Figure 4-7. Survey Grid Locations, Building 8 Office C

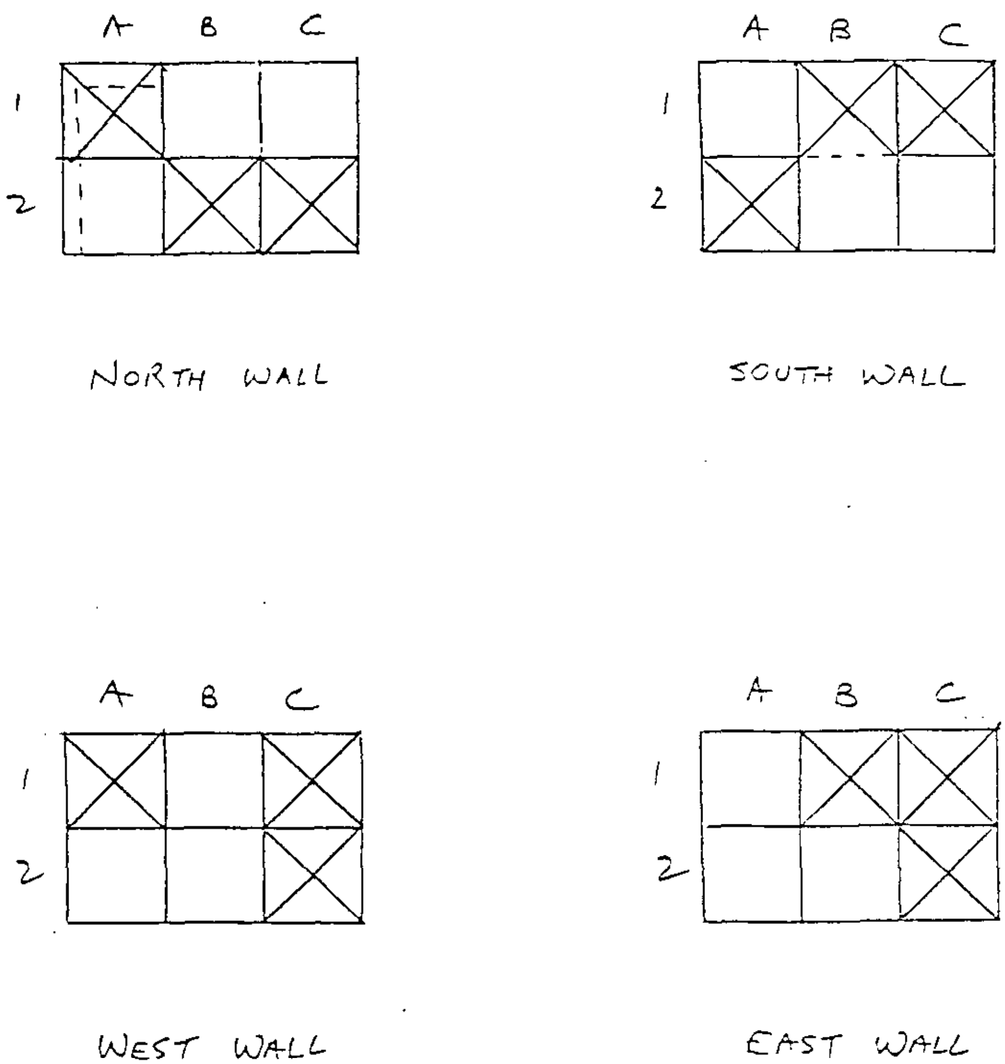


Figure 4-8. Survey Grid Locations, Building 8 Office D

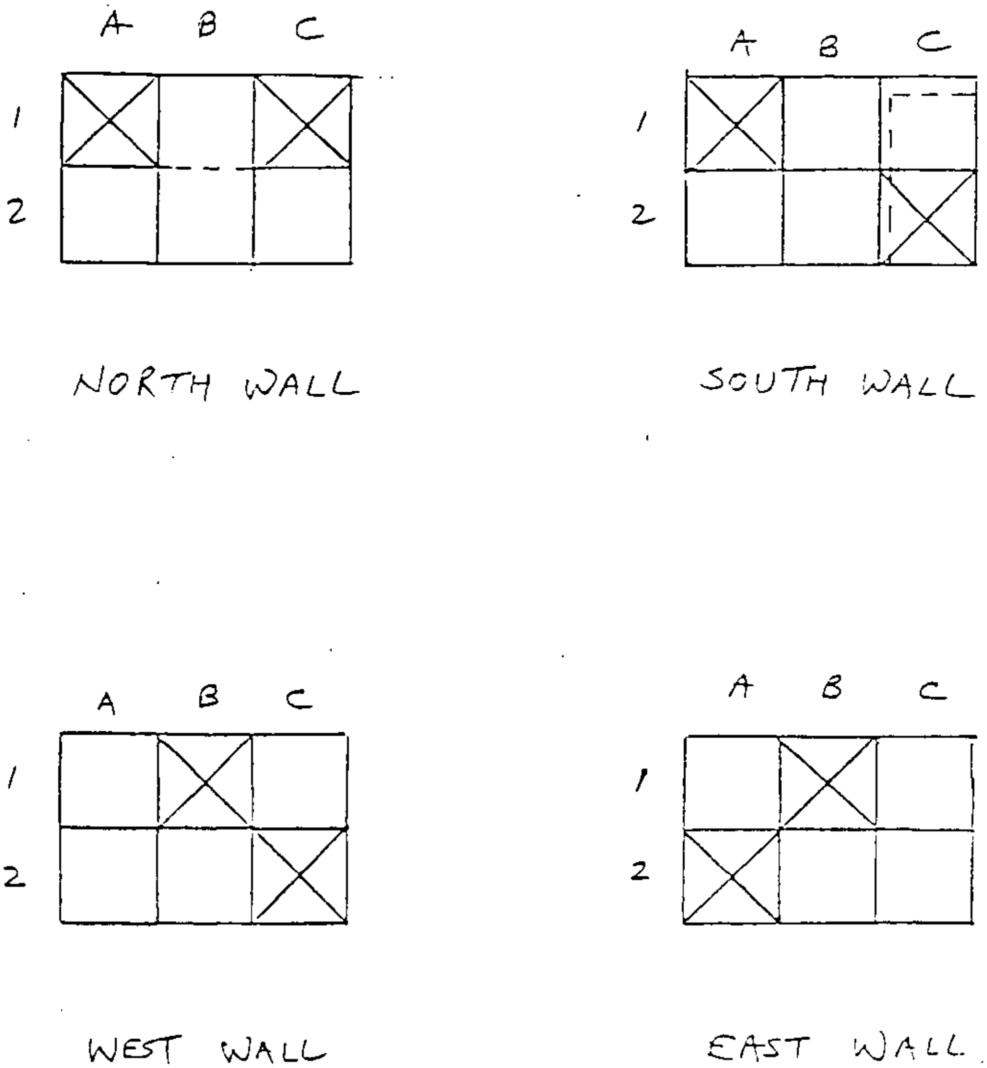


Figure 4-9. Survey Grid Locations, Building 8 Office E

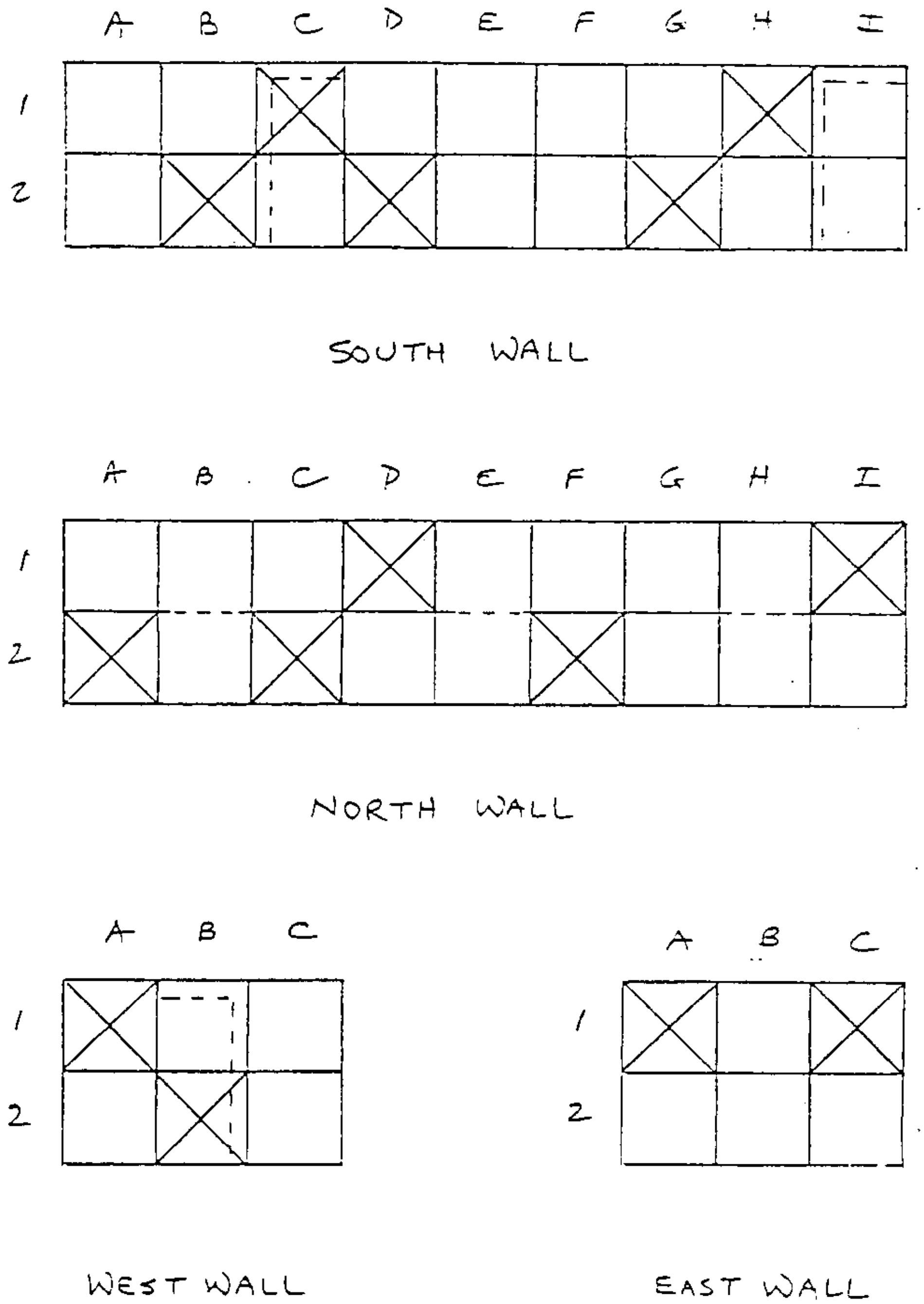


Figure 4-10. Survey Grid Locations, Building 8
Conference Room -- Room F

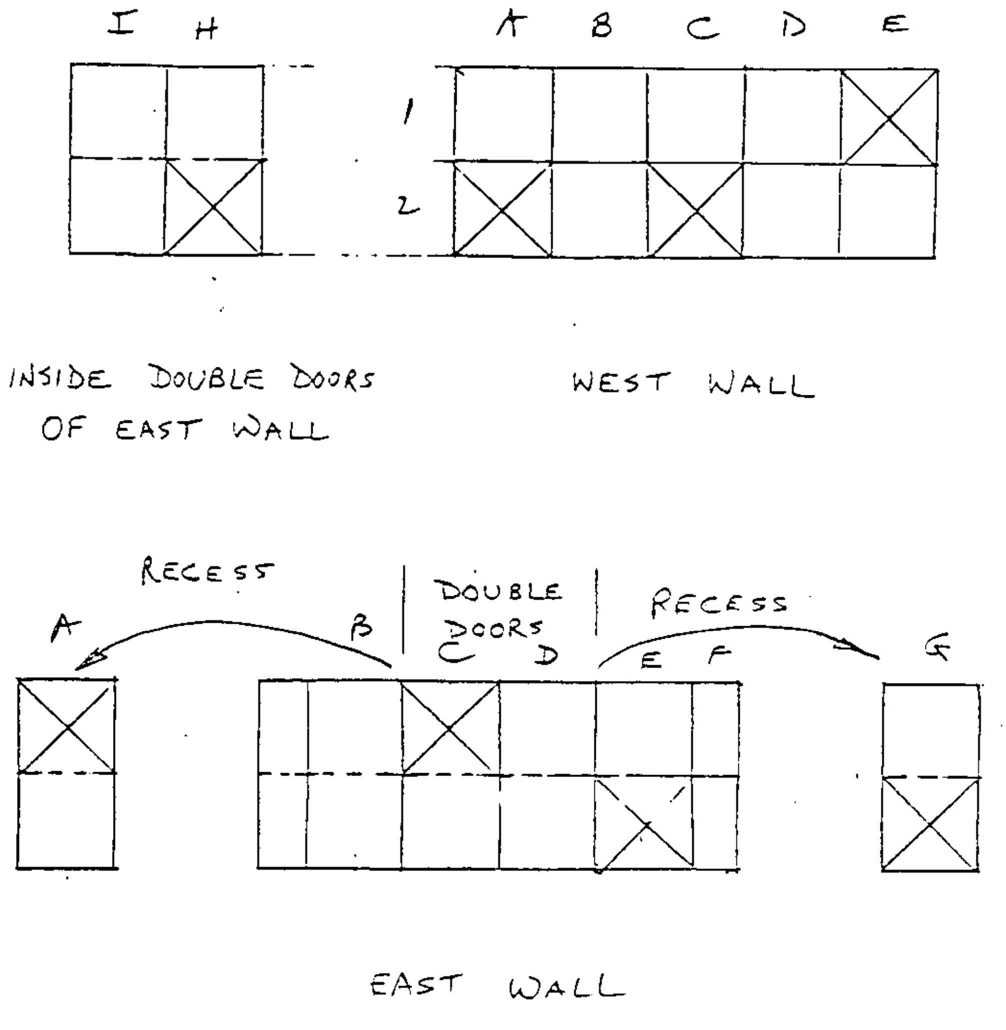


Figure 4-11. Survey Grid Locations, Building 8 Office Area -- Lobby -- Area G

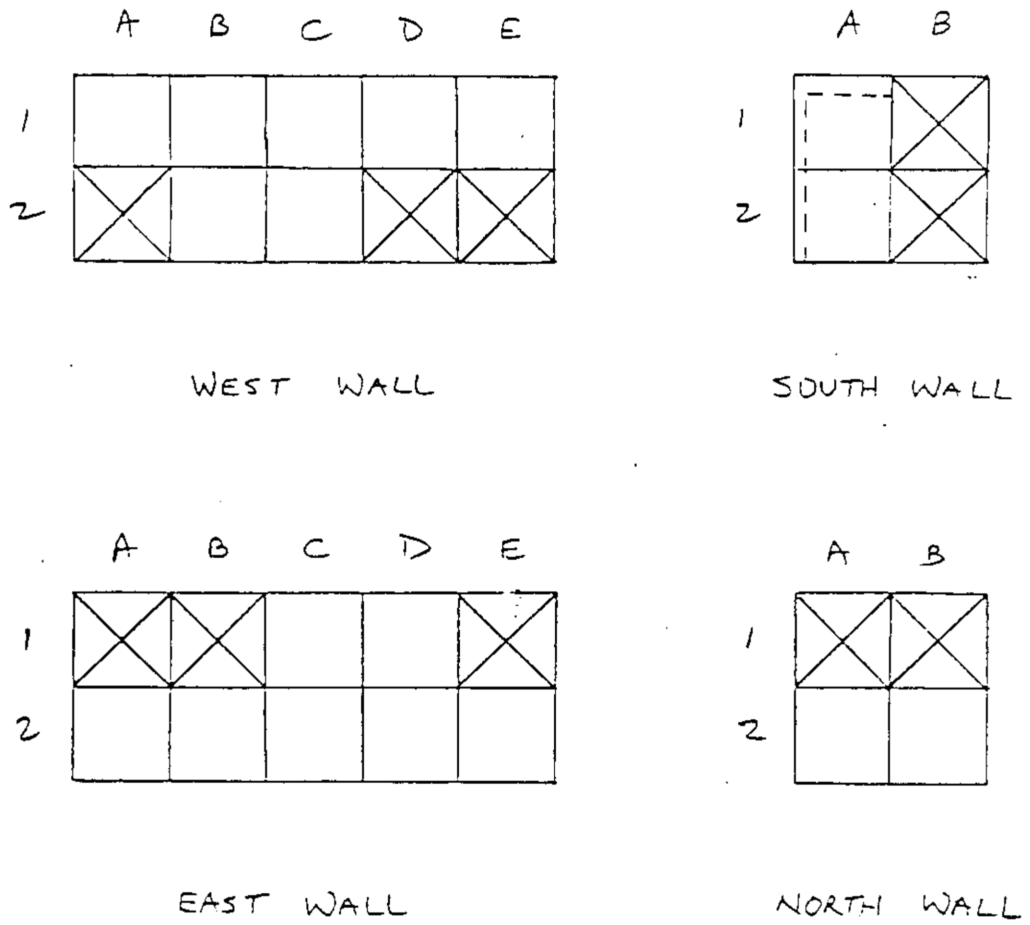


Figure 4-12. Survey Grid Locations, Building 8 Xerox Room -- Room H

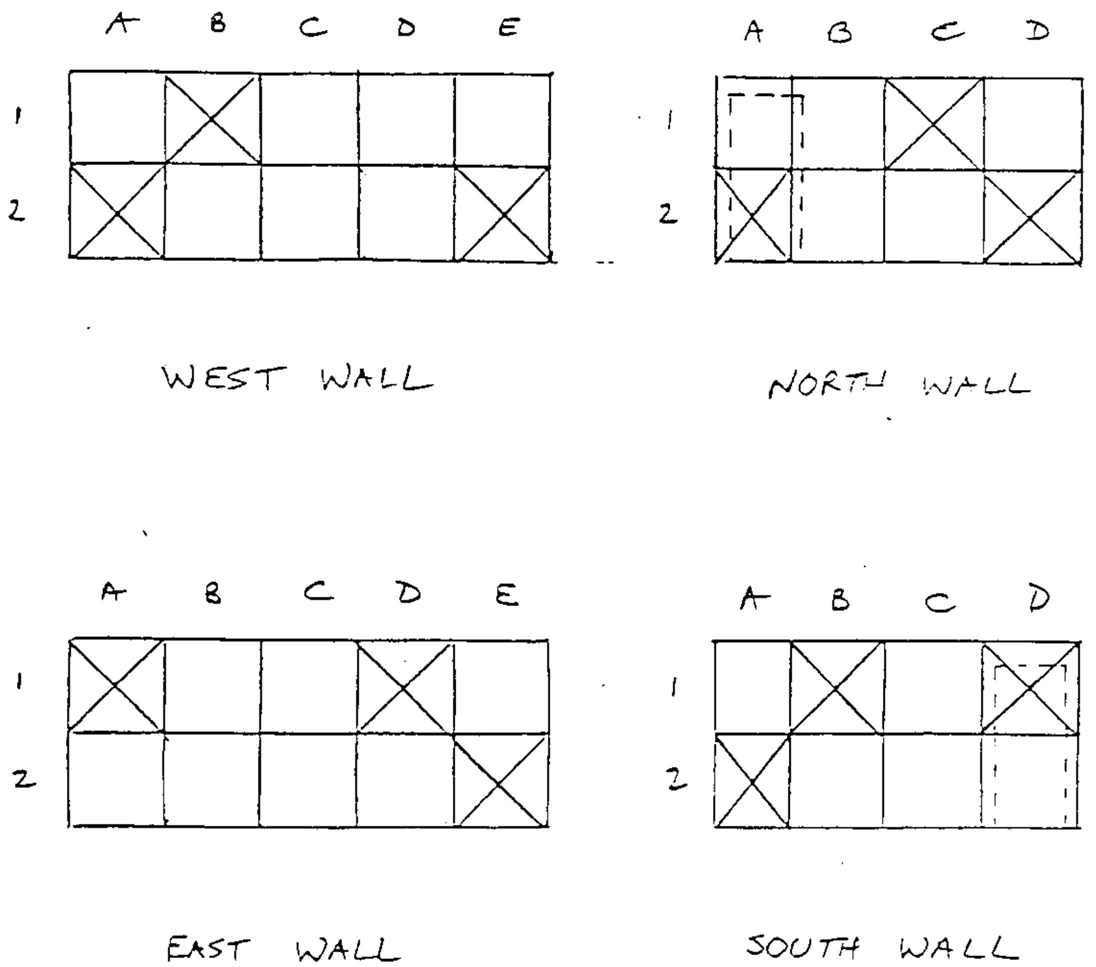


Figure 4-13. Survey Grid Locations, Building 8 Lunch Room -- Room I

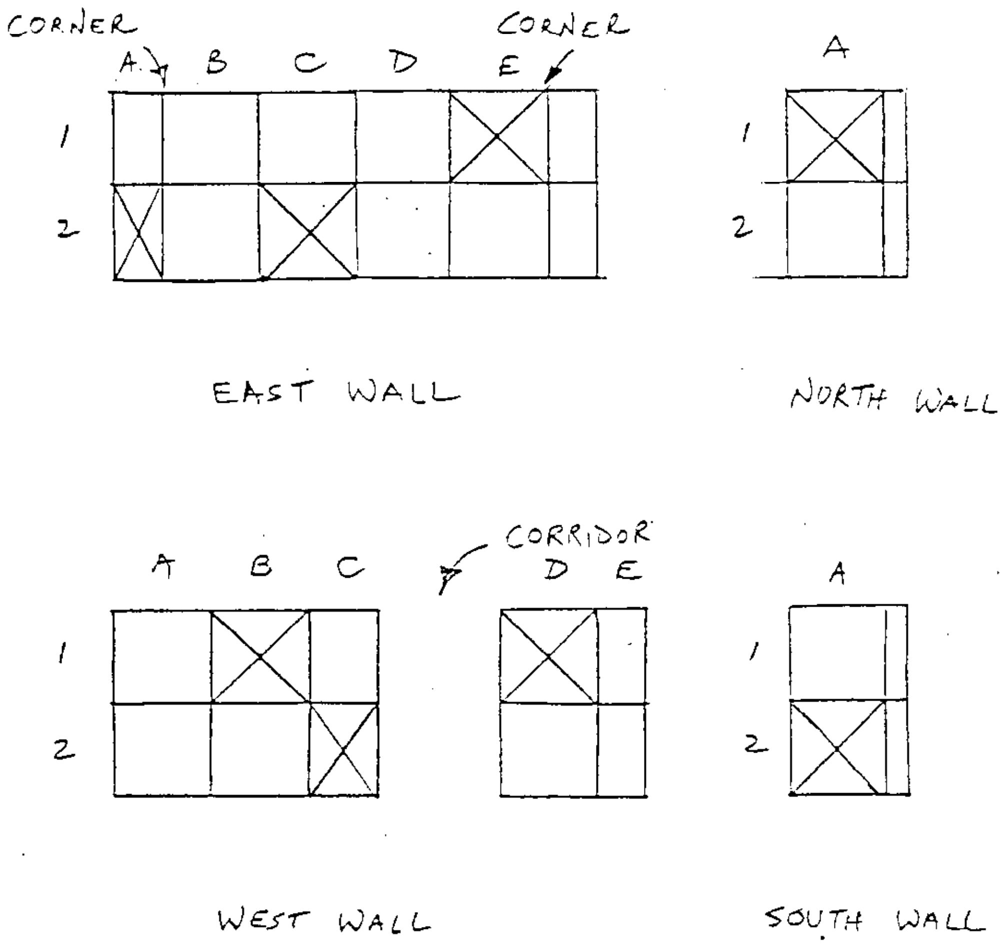


Figure 4-14. Survey Grid Locations, Building 8 Office Area -- Vending Machines Hallway -- Area J

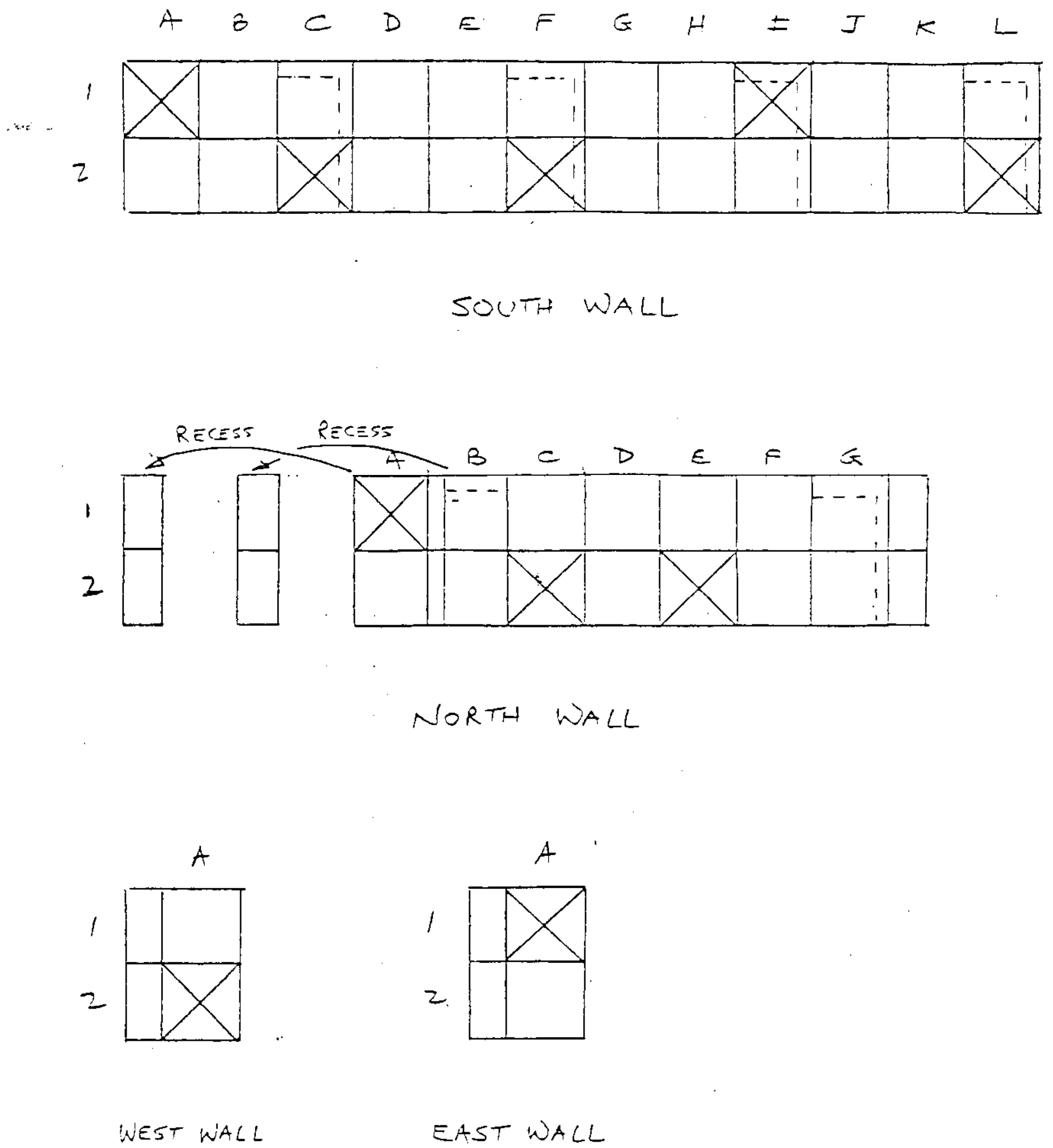


Figure 4-15. Survey Grid Locations, Building 8 Office Area -- South Corridor -- Area K

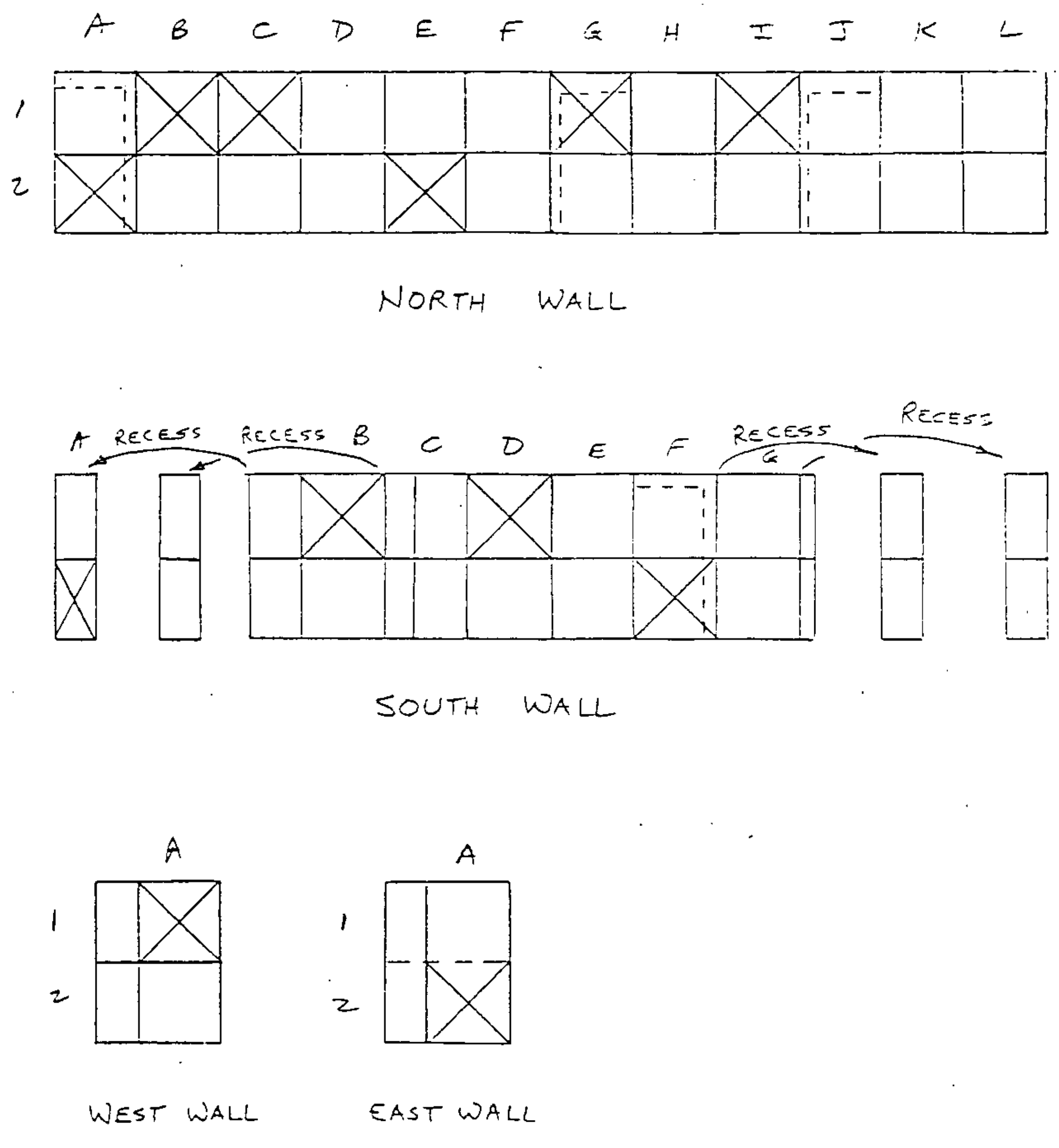


Figure 4-16. Survey Grid Locations, Building 8 Office Area -- North Corridor -- Area L

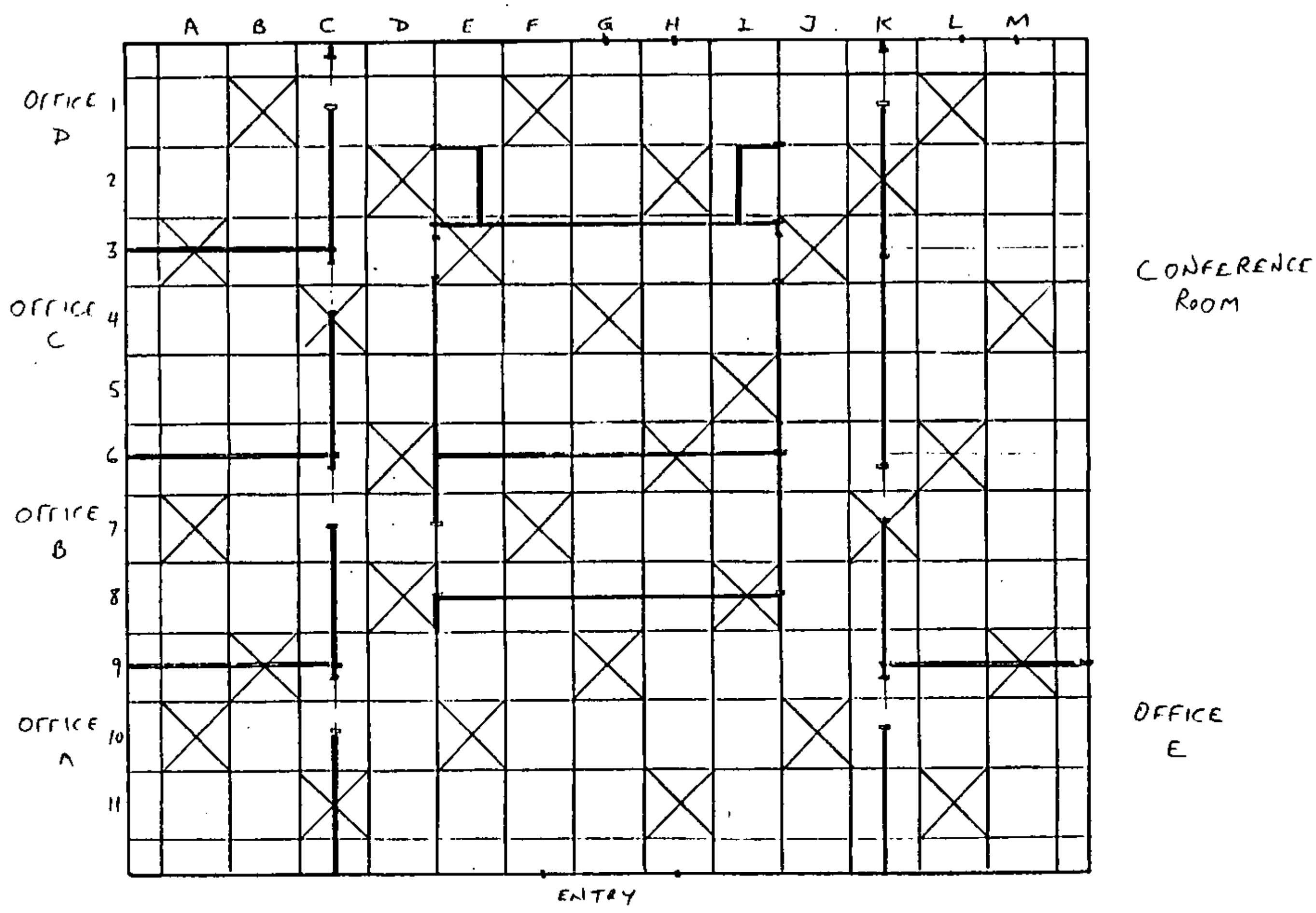


Figure 4-17. Survey Grid Locations, Building 8 Office Area -- Ceiling

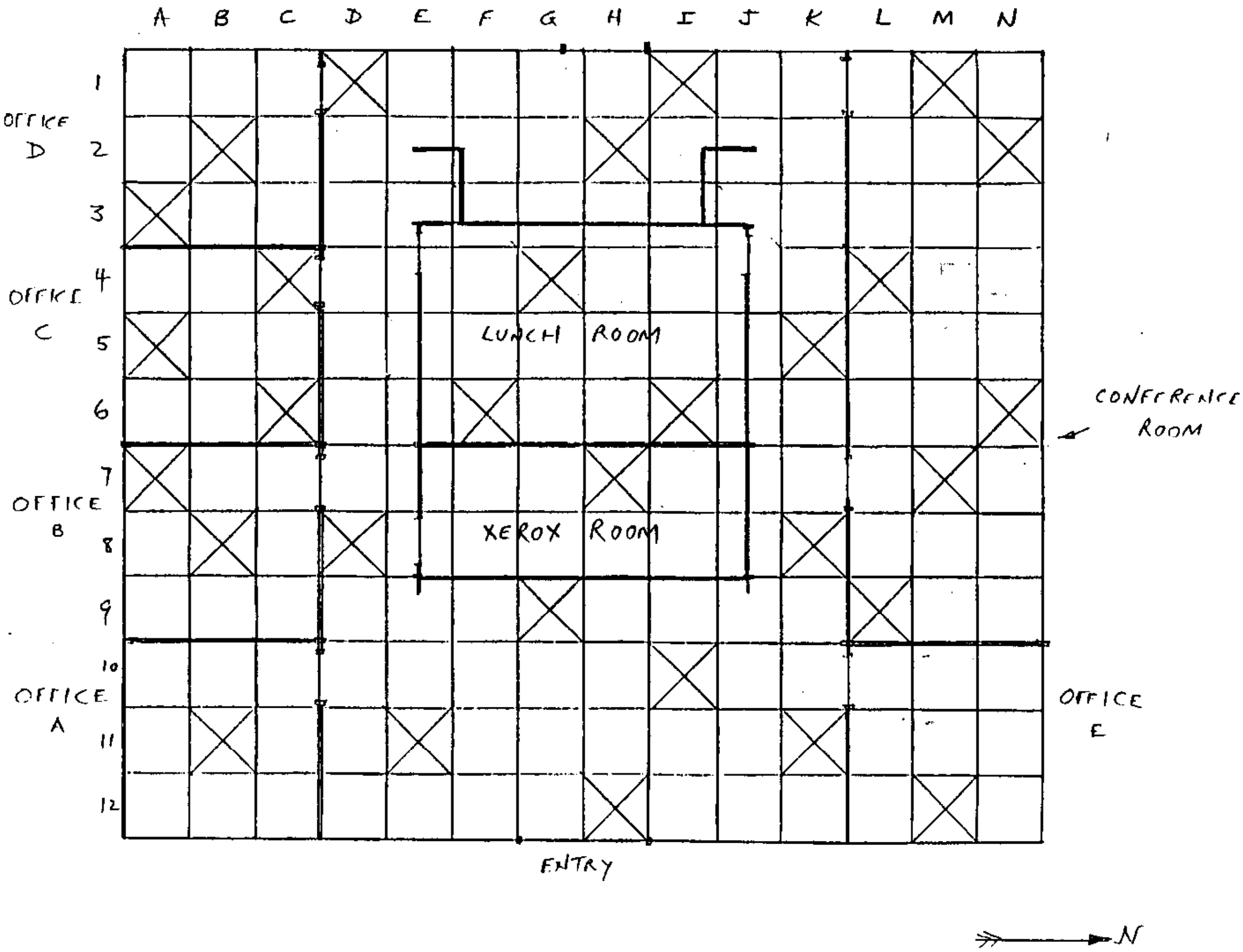


Figure 4-18. Survey Grid Locations, Building 8 Office Area -- Floor

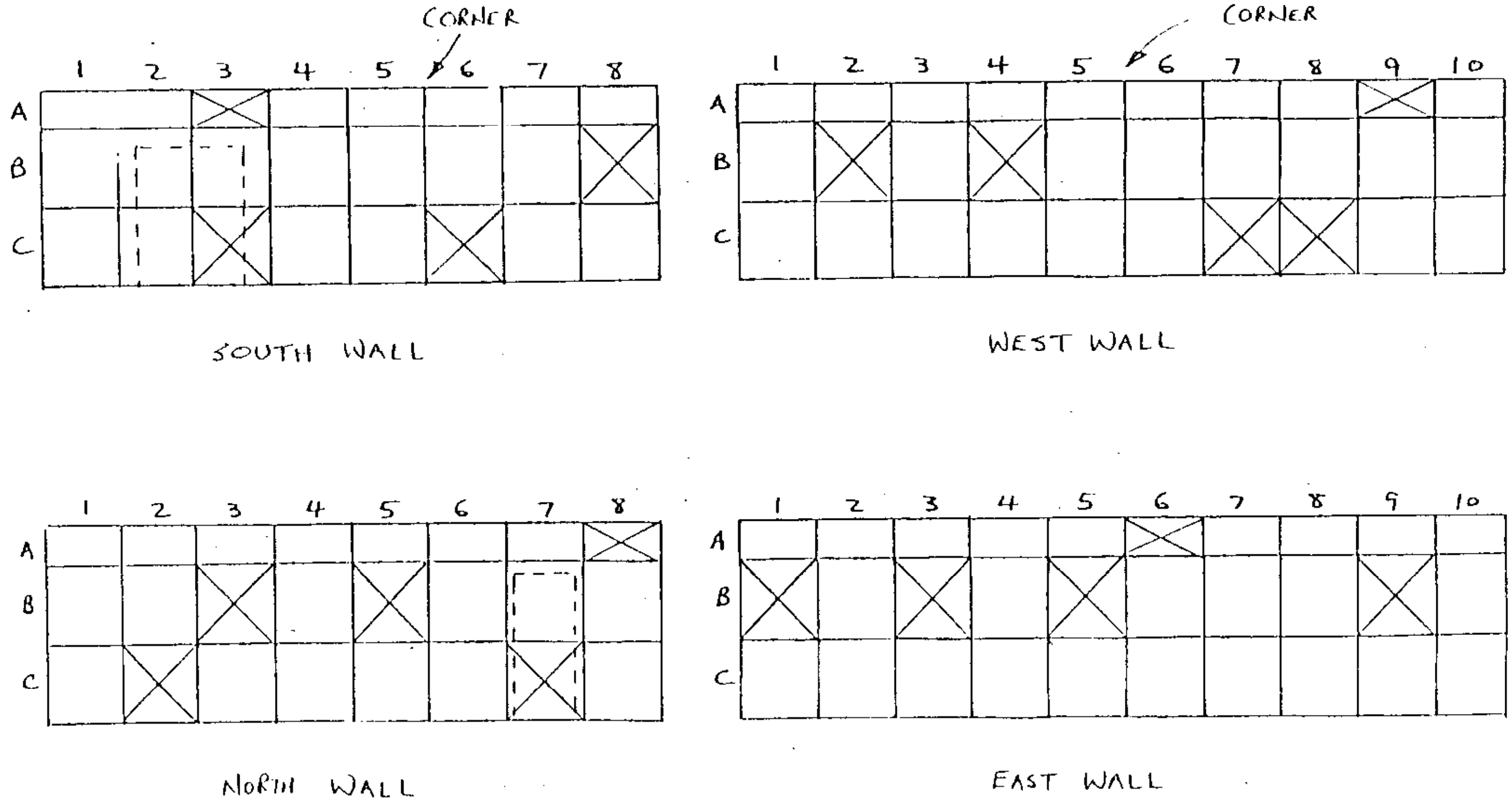


Figure 4-19. Survey Grid Locations, Building 8 Mechanical Equipment Room -- Room M

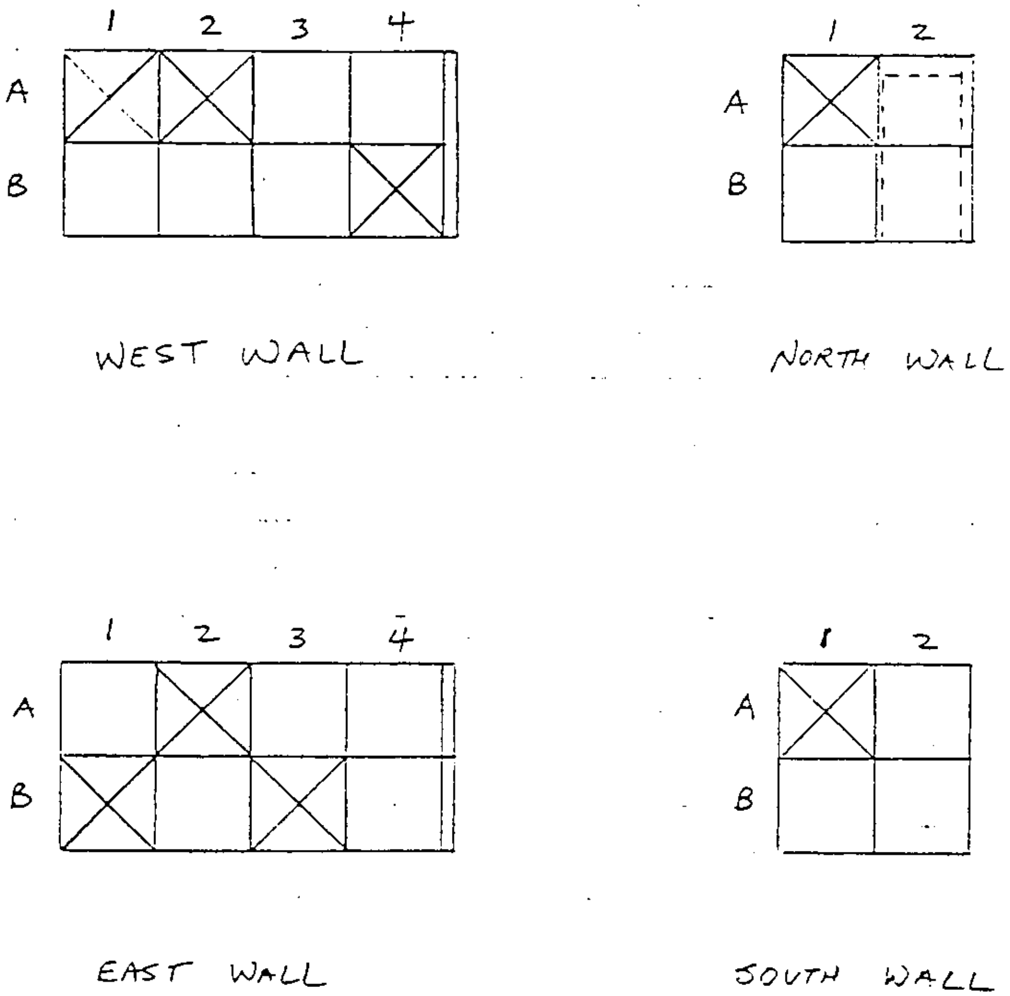


Figure 4-20. Survey Grid Locations, Building 8 Health Physics Office -- Room N

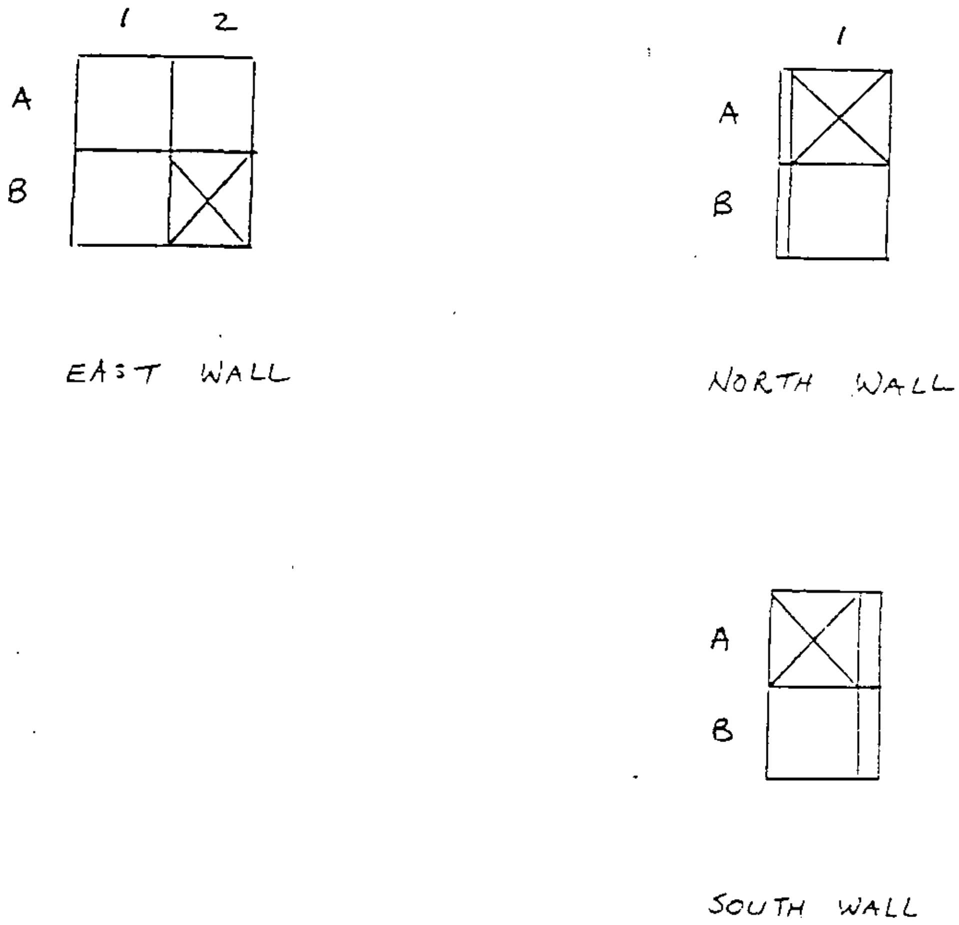


Figure 4-21. Survey Grid Locations, Building 8 Janitor's Closet -- Room 0

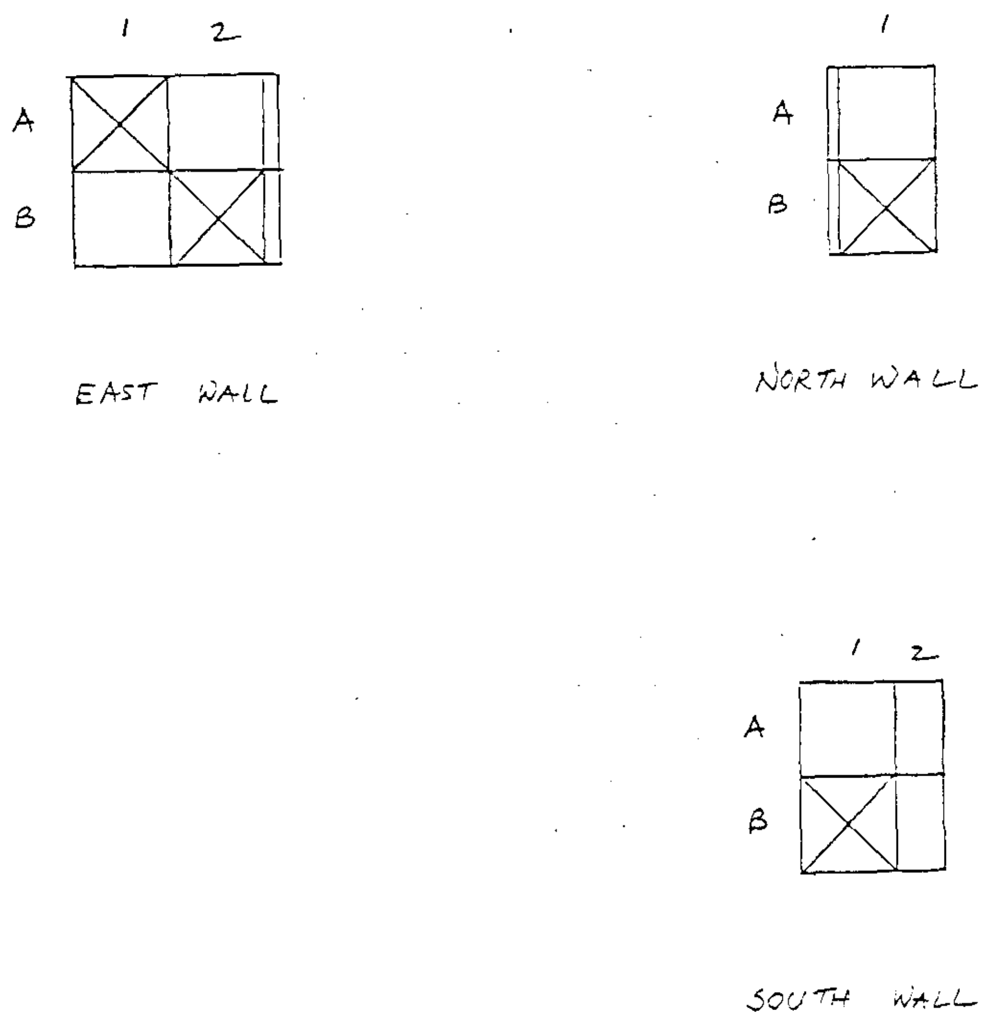


Figure 4-22. Survey Grid Locations, Building 8 Office Auxiliary Area -- Decon Room -- Room P

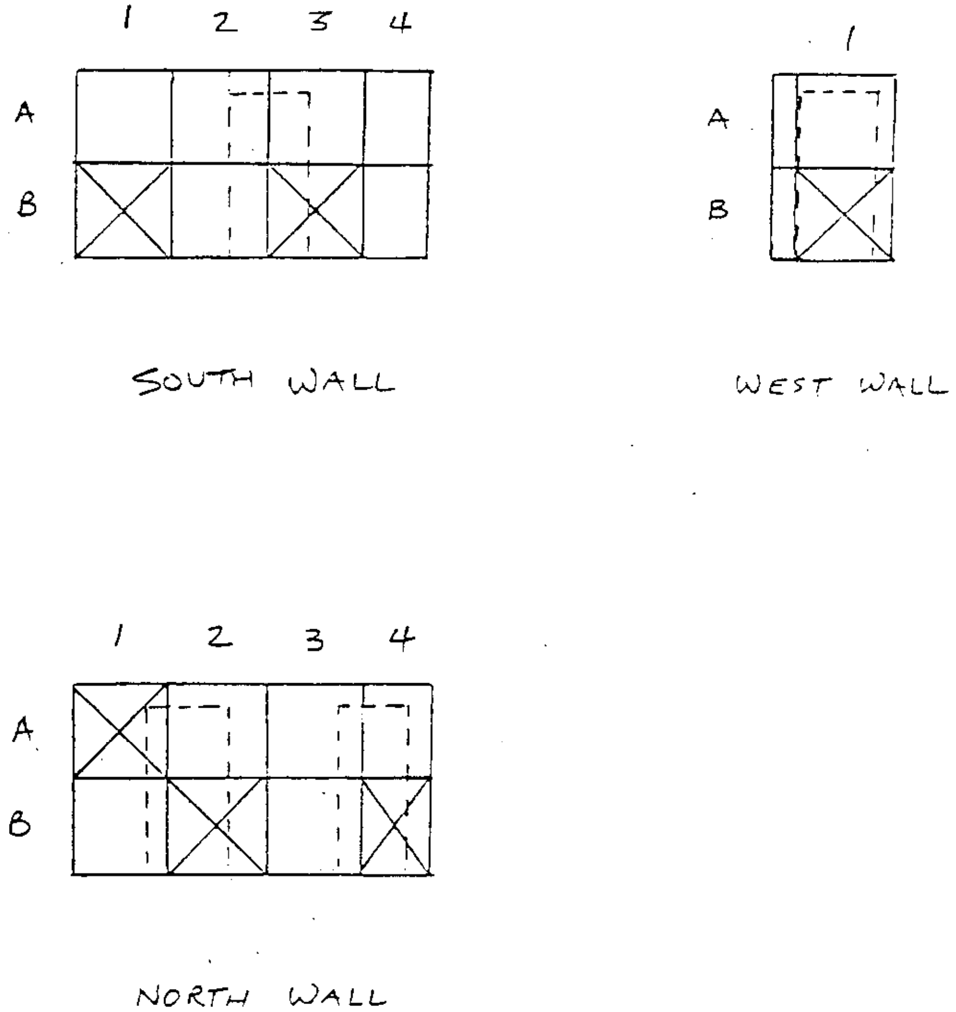


Figure 4-23. Survey Grid Locations, Building 8 Office Auxiliary Area, East Corridor (Adjacent to Mechanical Equipment Room) -- Room Q

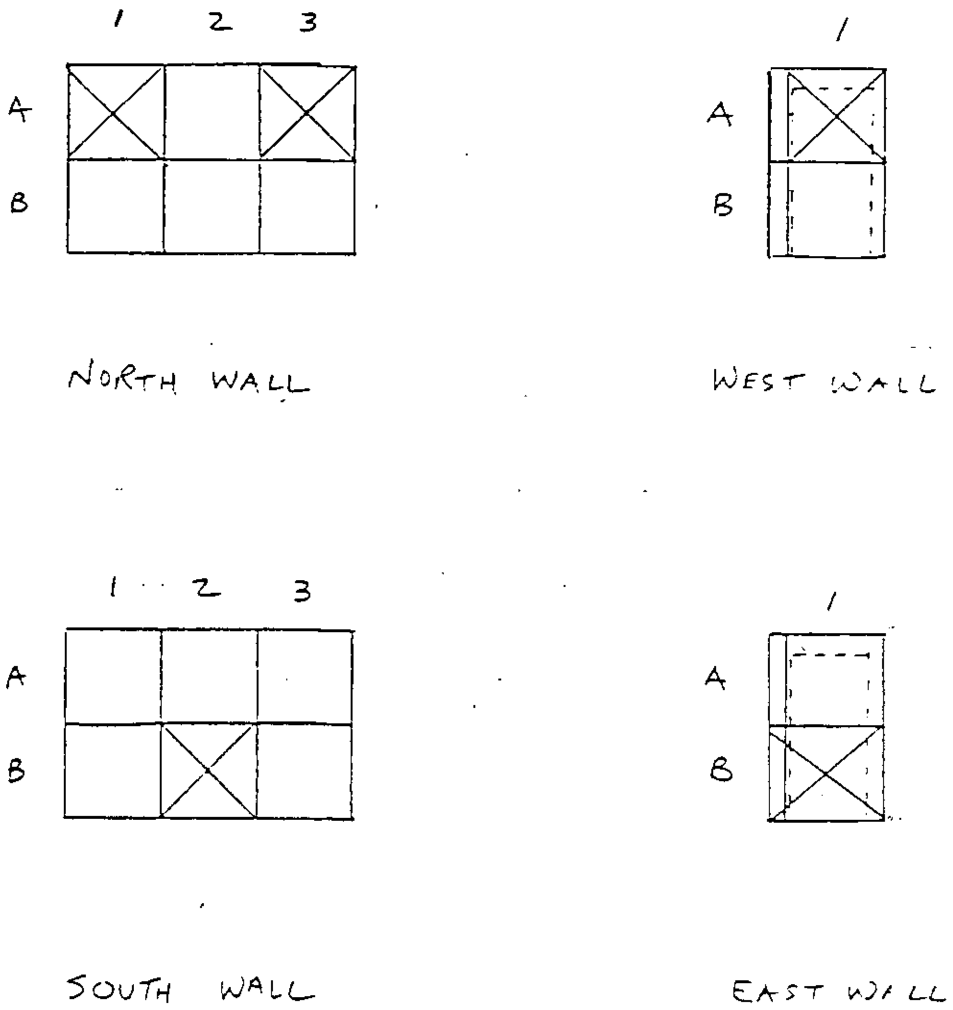


Figure 4-24. Survey Grid Locations, Building 8 Office Auxiliary Area, Air-Lock Corridor -- Area R

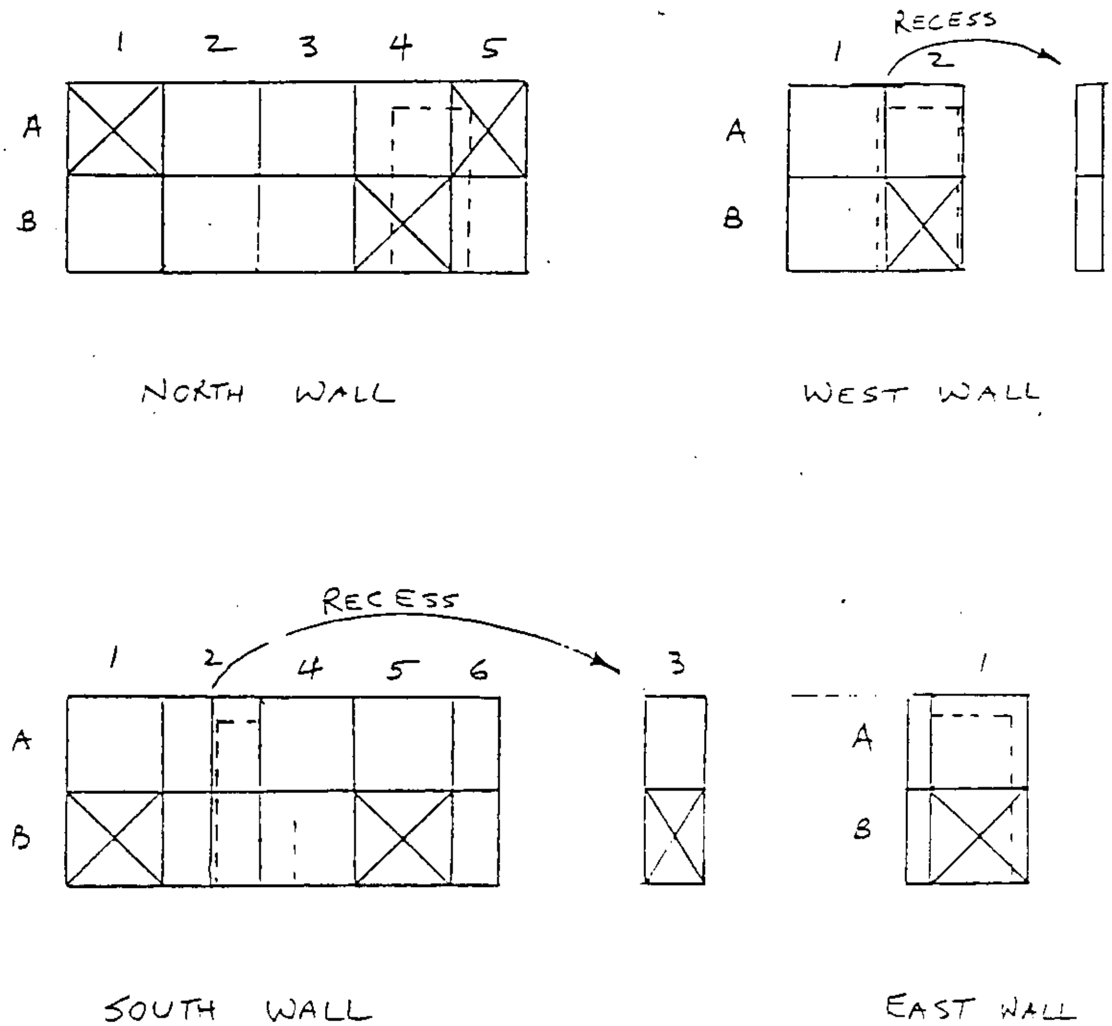


Figure 4-25. Survey Grid Locations, Building 8 Office Auxiliary Area, West Corridor (Adjacent to Shower Room) -- Area S

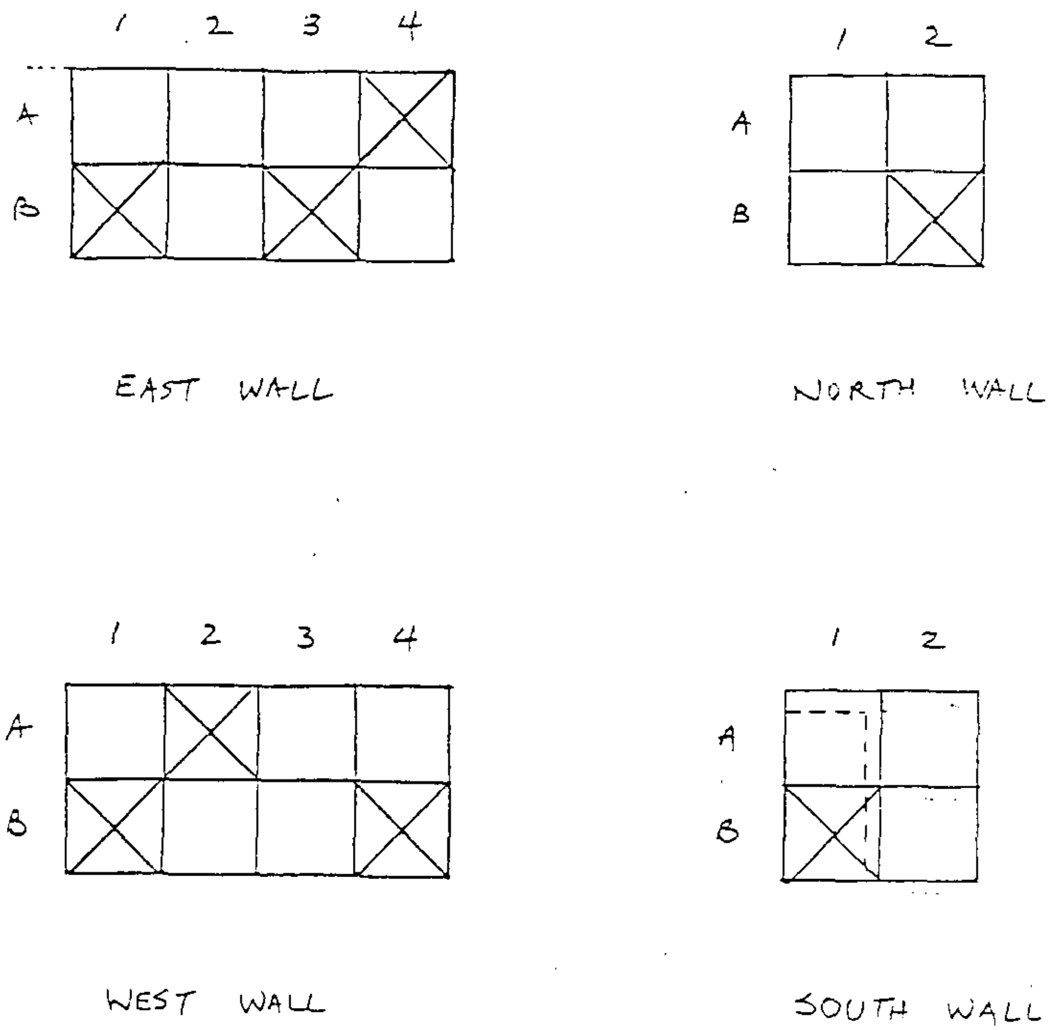


Figure 4-26. Survey Grid Locations, Building 8 Office Auxiliary Area -- Men's Room -- Room T

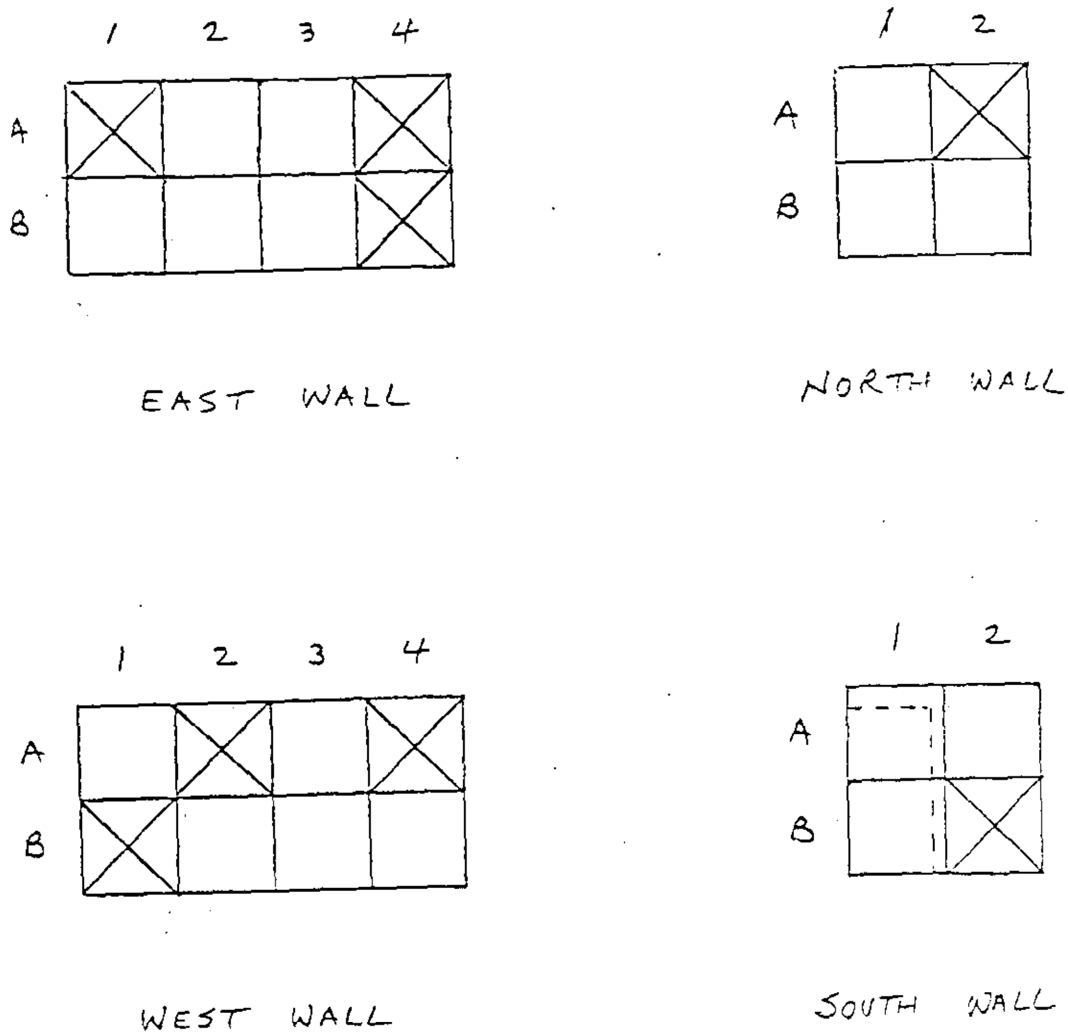


Figure 4-27. Survey Grid Locations, Building 8 Office Auxiliary Area -- Women's Room -- Room U

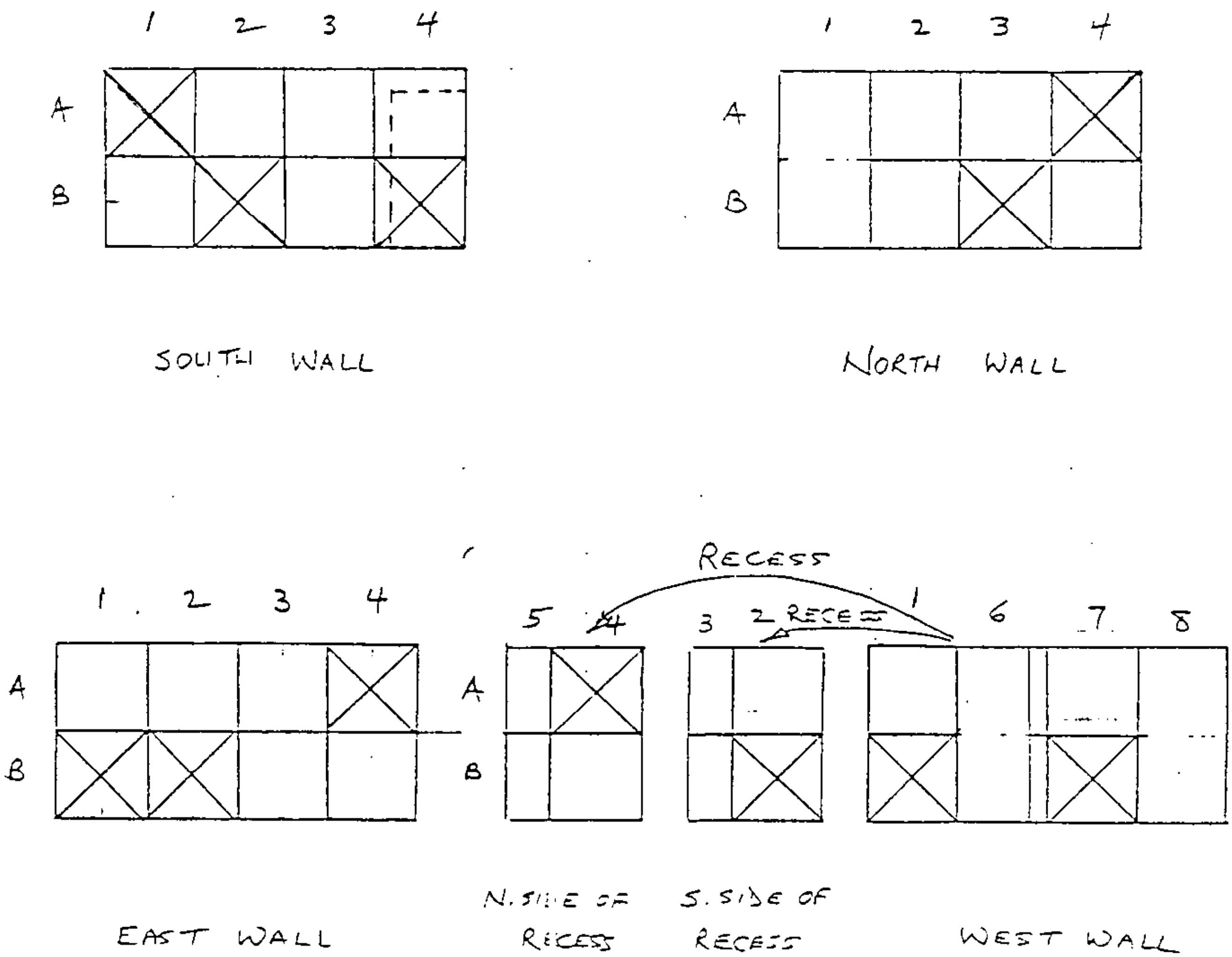


Figure 4-28. Survey Grid Locations, Building 8 Office Auxiliary Area -- Change Room -- Room V

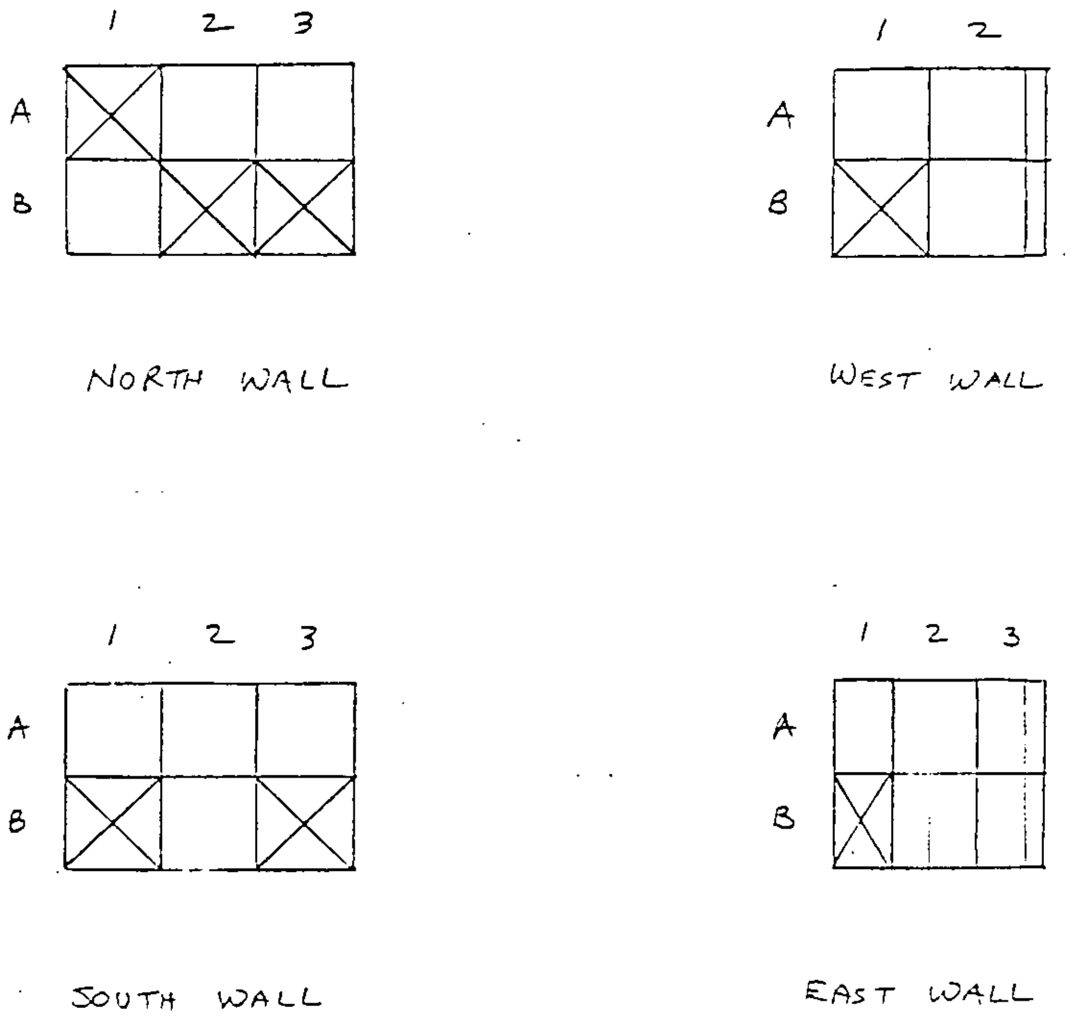


Figure 4-29. Survey Grid Locations, Building 8 Office Auxiliary Area -- Shower Room -- Room W

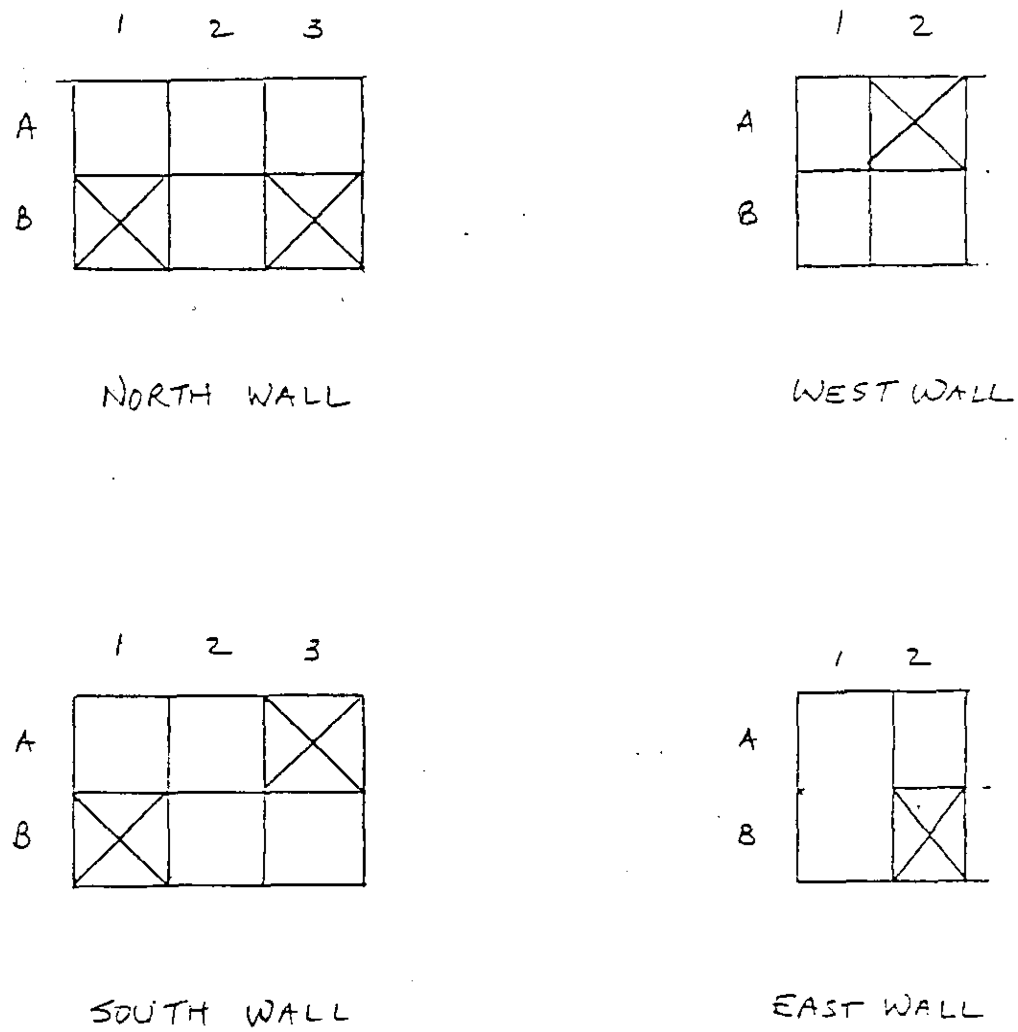


Figure 4-30. Survey Grid Locations, Building 8 Office Auxiliary Area -- Toilet Room -- Room X

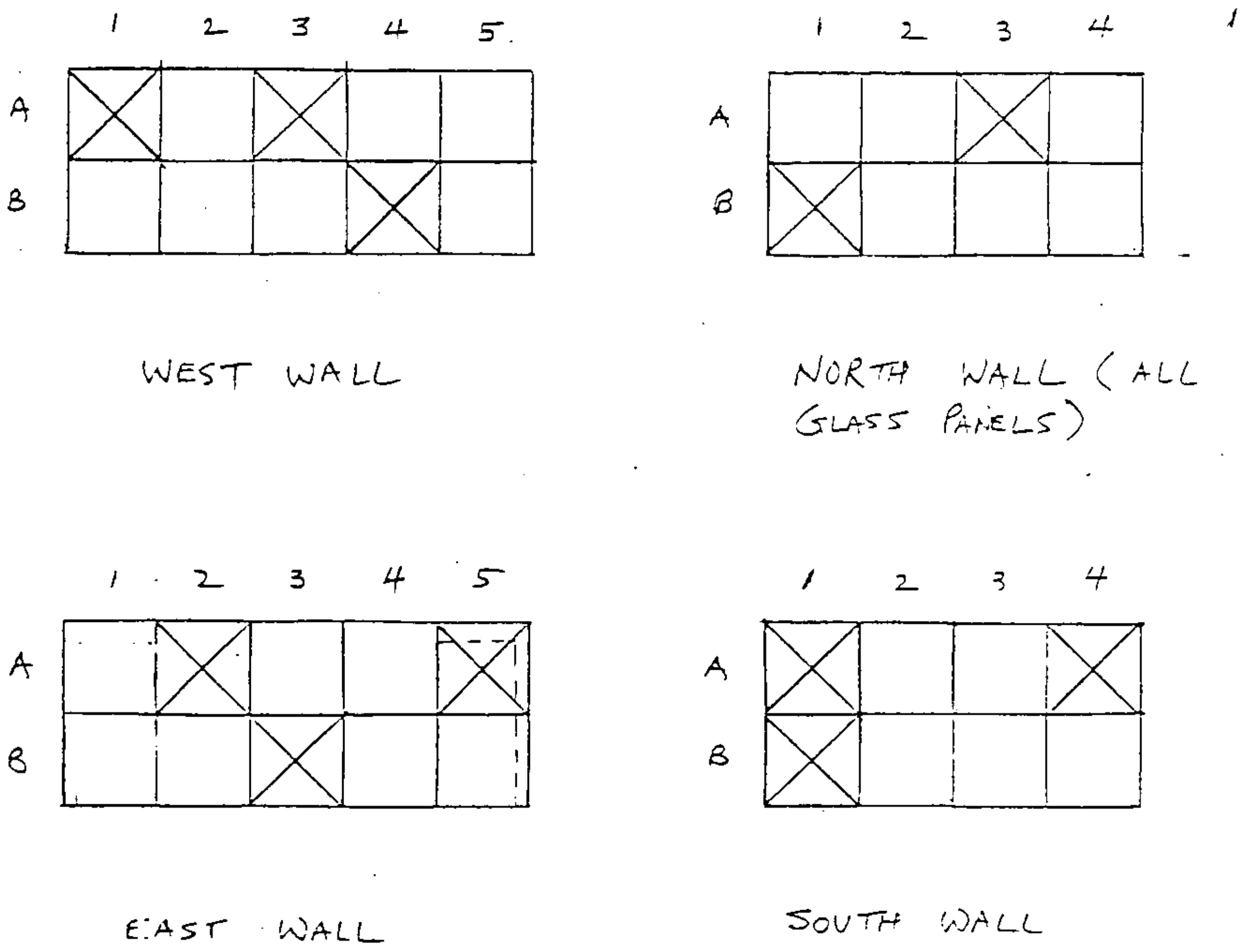


Figure 4-31. Survey Grid Locations, Building 8 Office Auxiliary Area -- Supervisor's Office -- Room Y

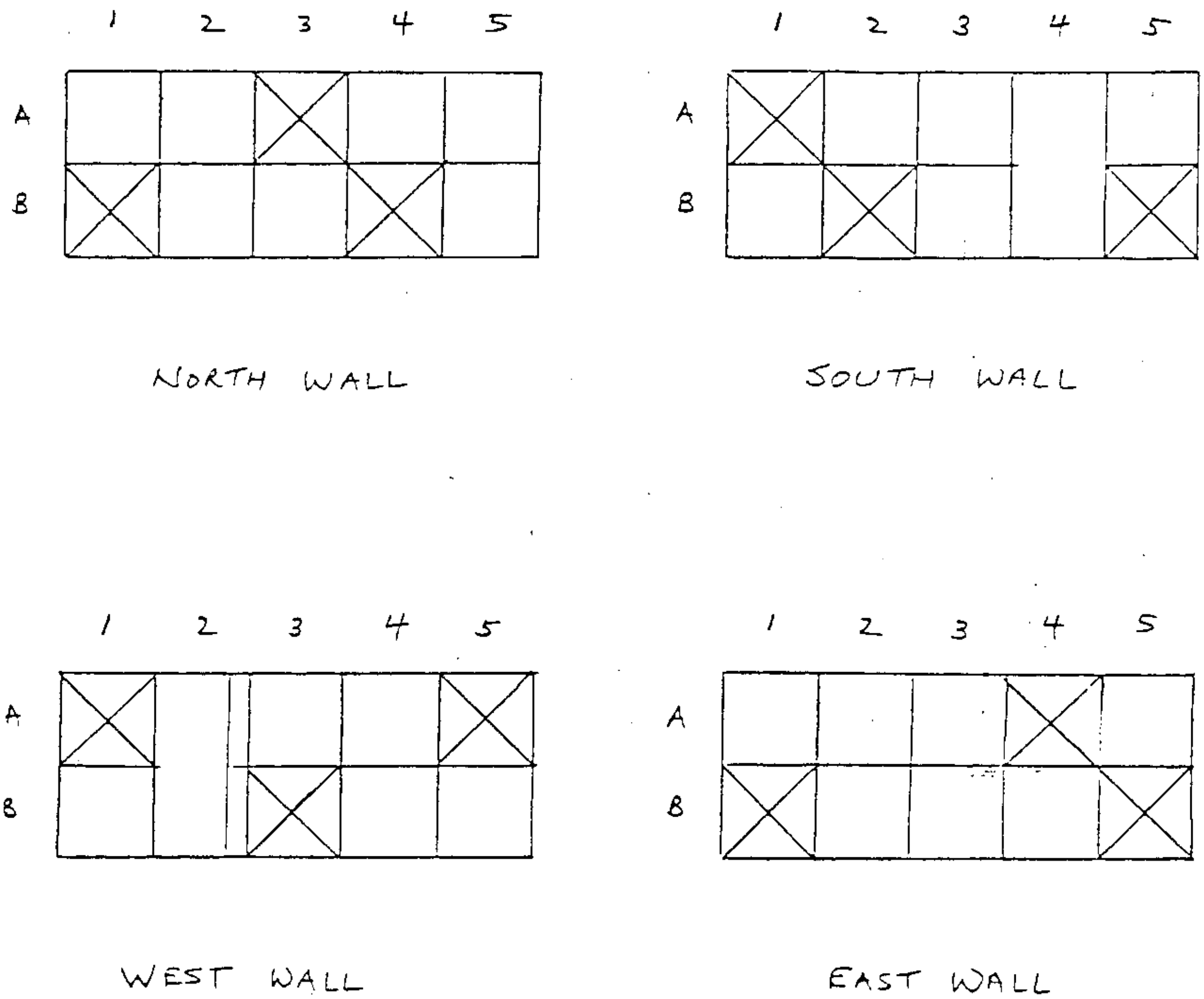


Figure 4-32. Survey Grid Locations, Building 8 Office Auxiliary Area -- Locker Room -- Room Z

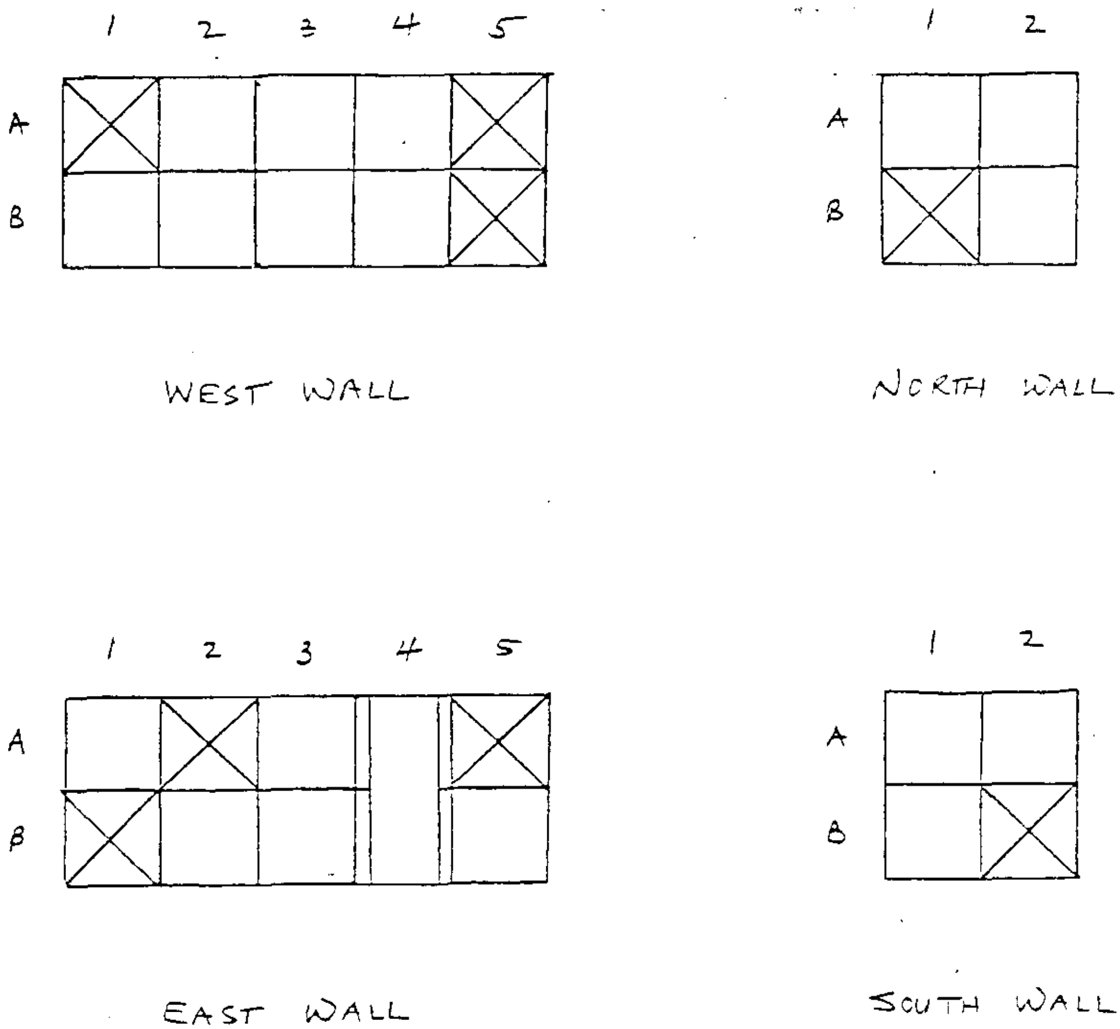


Figure 4-33. Survey Grid Locations, Building 8 Office Auxiliary Area -- Laundry Room -- Room ZZ

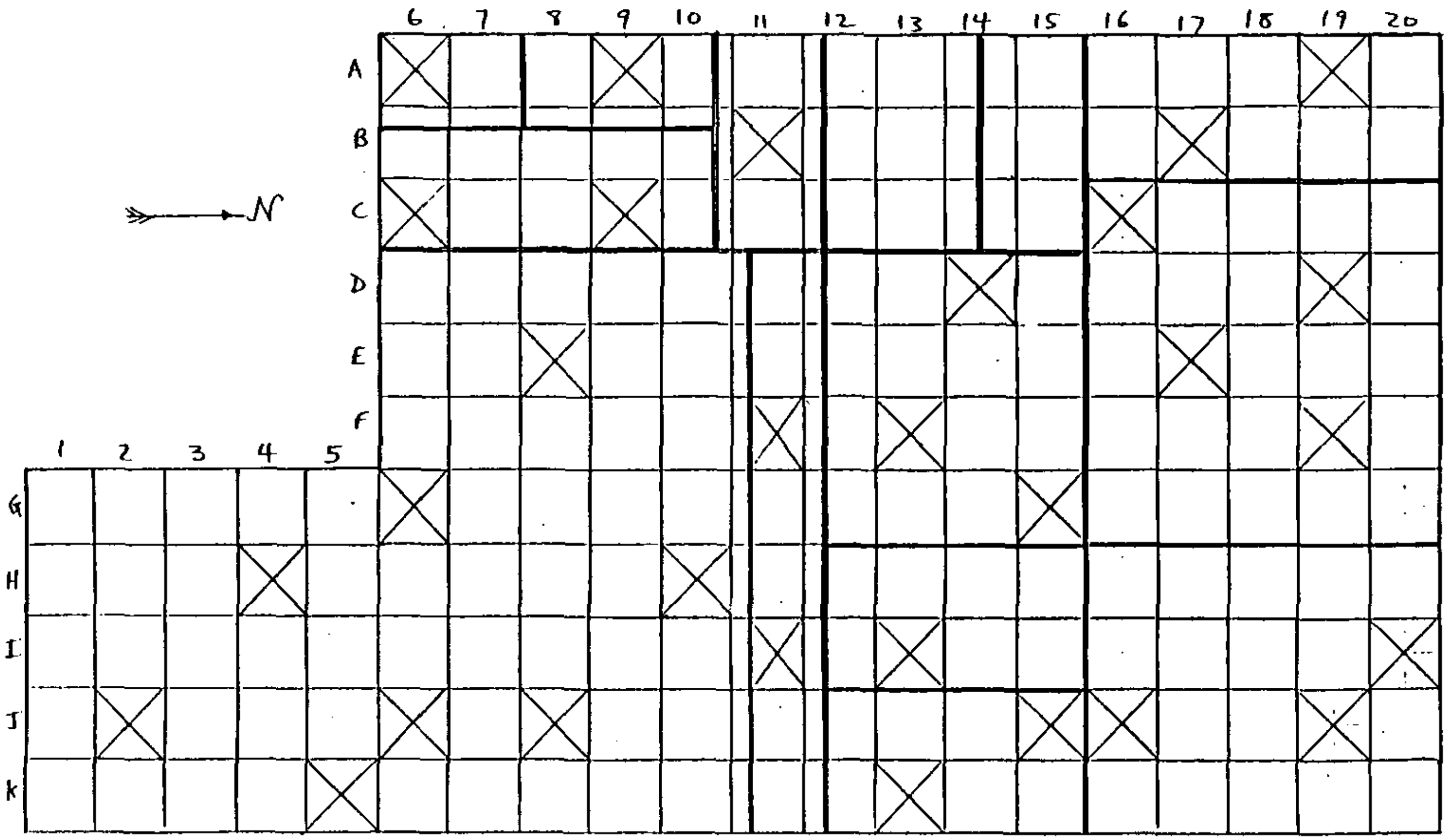


Figure 4-34. Survey Grid Locations, Building 8 Office Auxiliary Area -- Ceiling

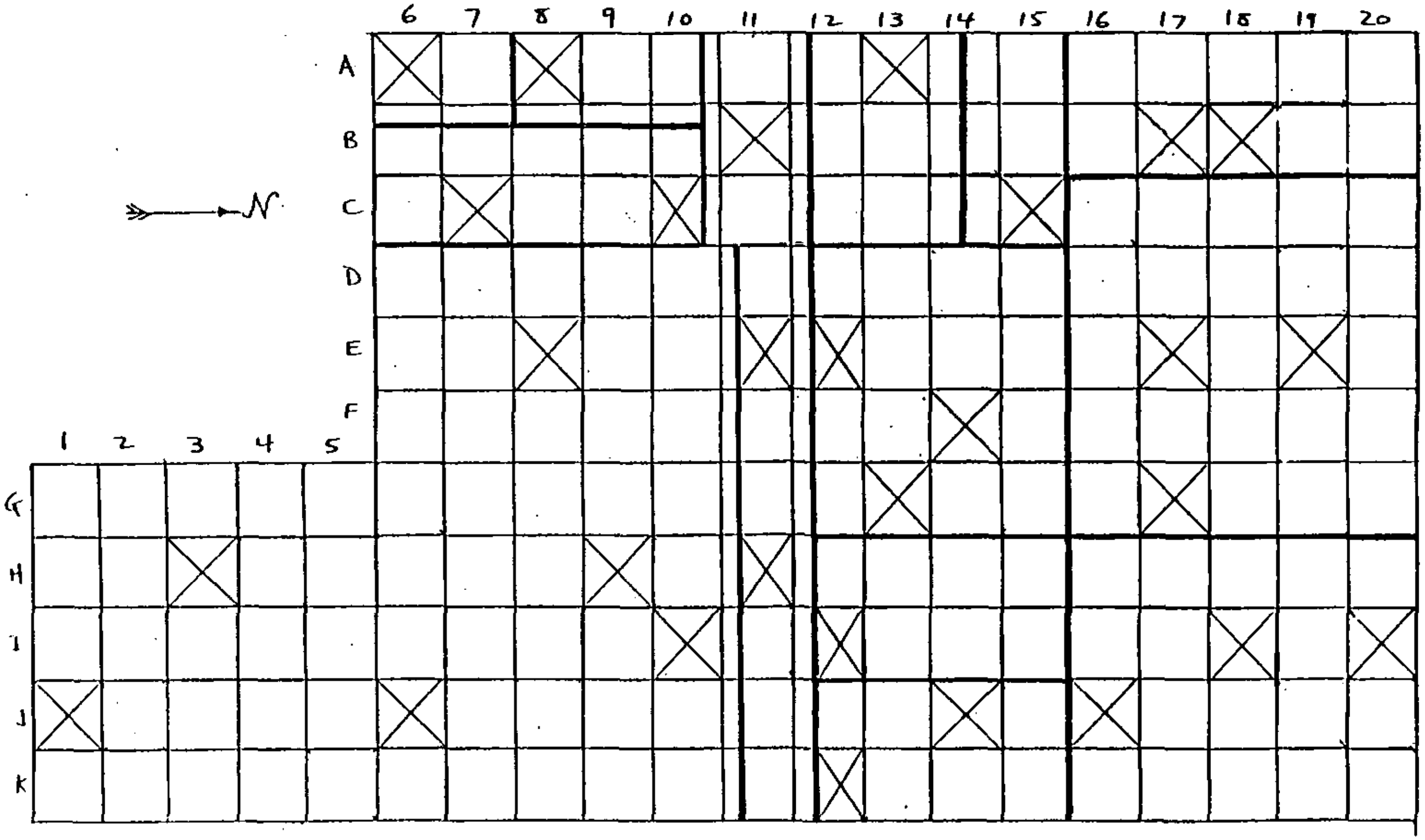


Figure 4-35. Survey Grid Locations, Building 8 Office Auxiliary Area -- Floor

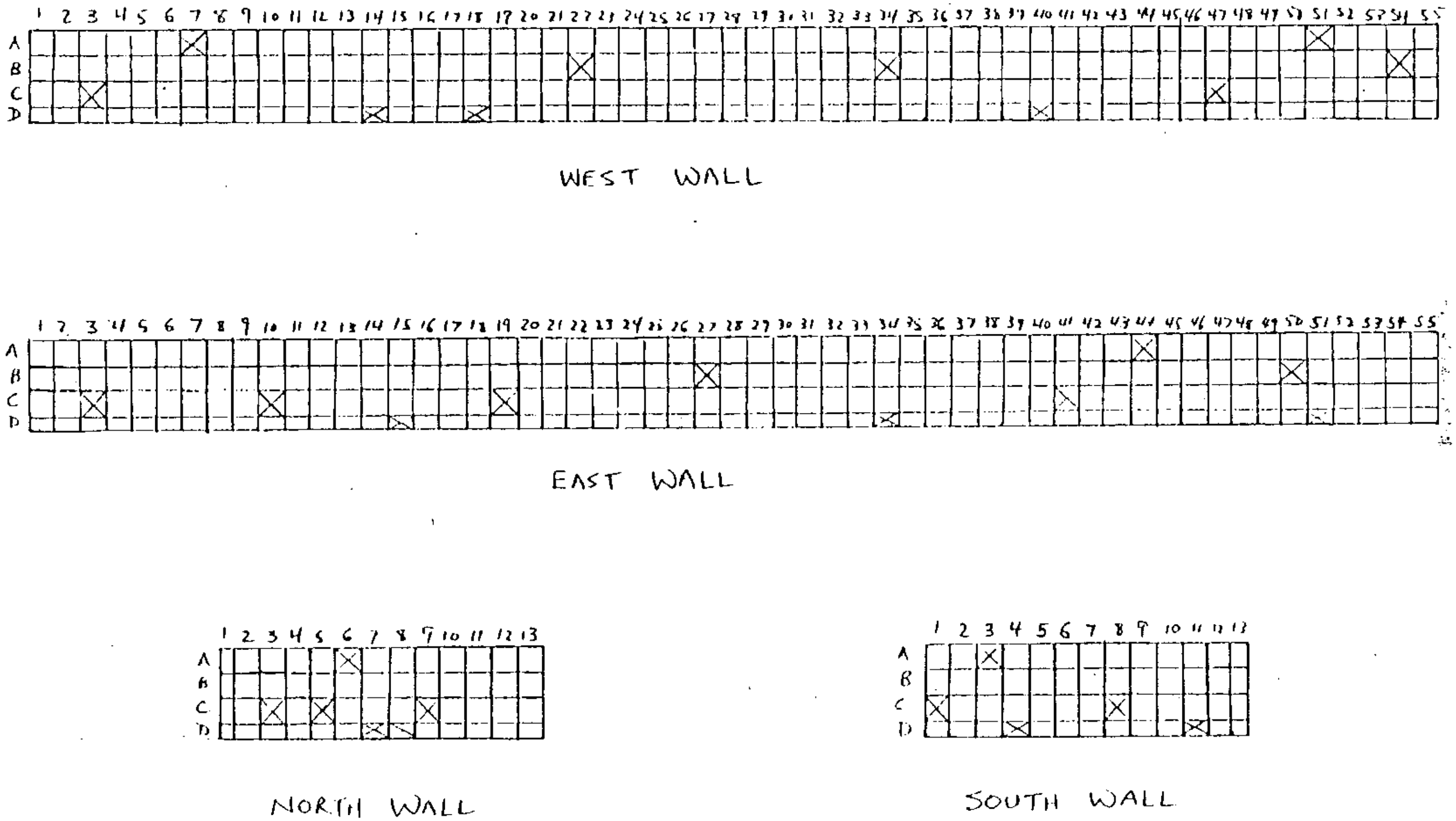


Figure 4-36. Survey Grid Locations, Building 8 Penthouse -- Walls

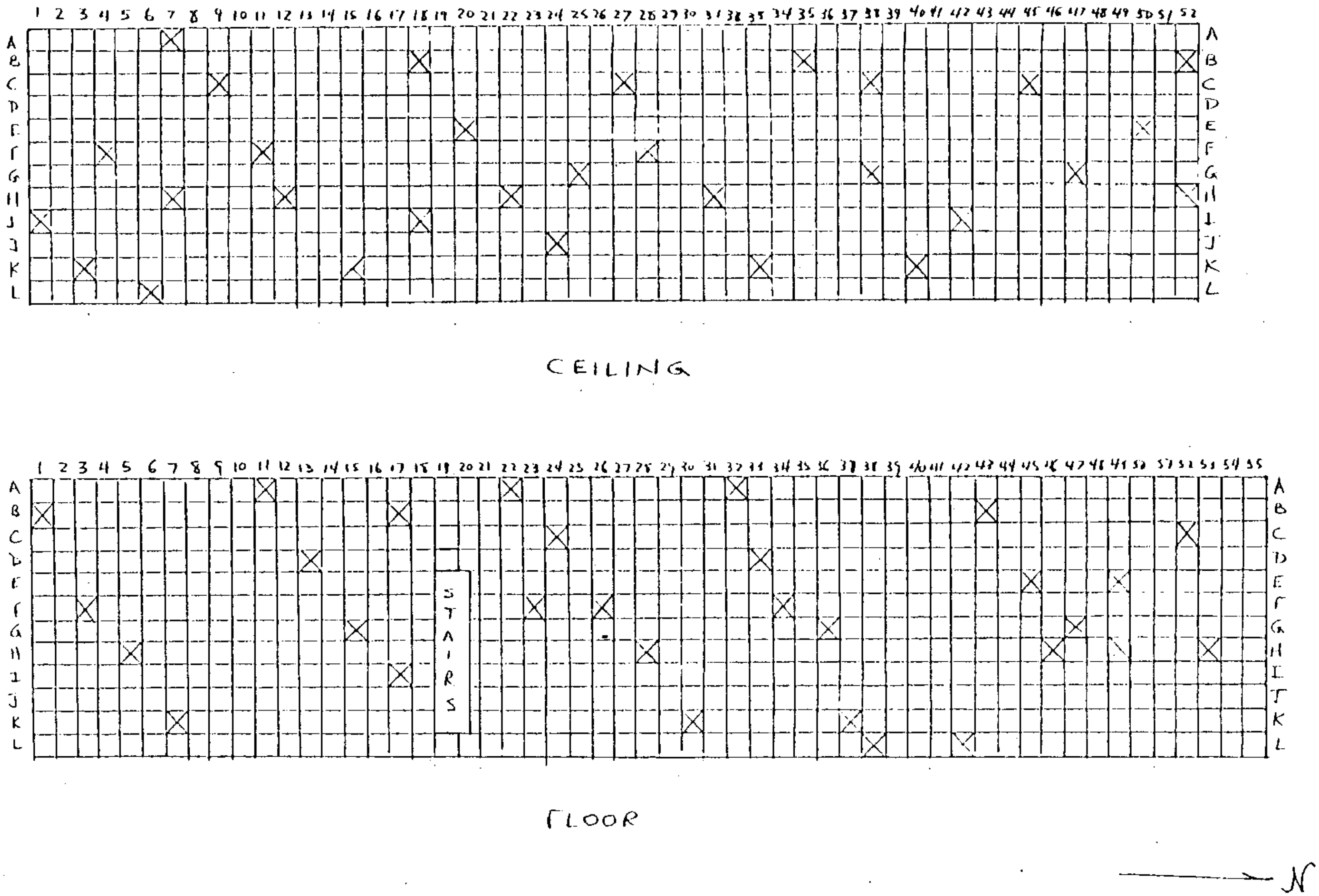


Figure 4-37. Survey Grid Locations, Building 8 Penthouse -- Ceiling and Floor

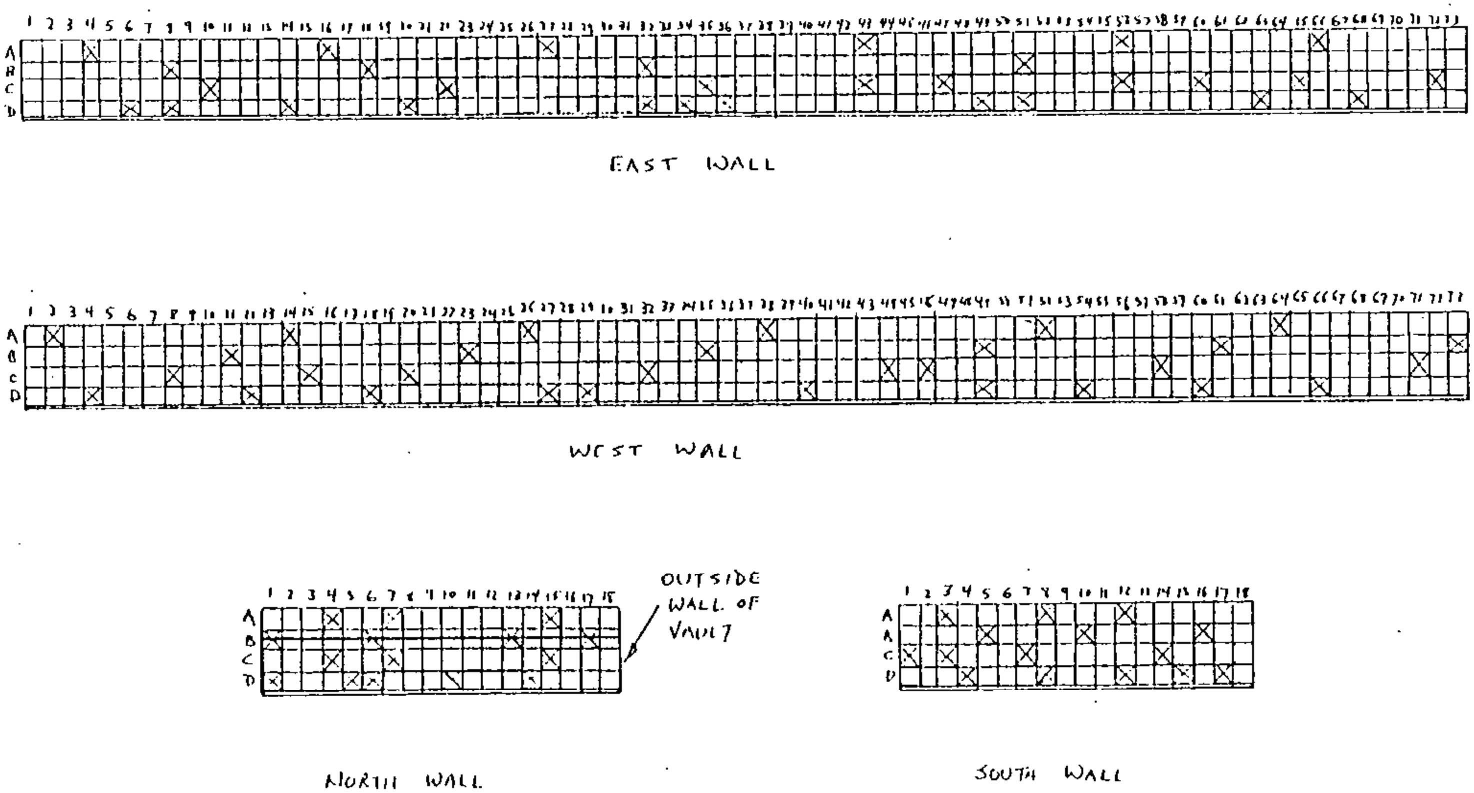


Figure 4-38. Survey Grid Locations, Building 8 Controlled Access Area -- Walls

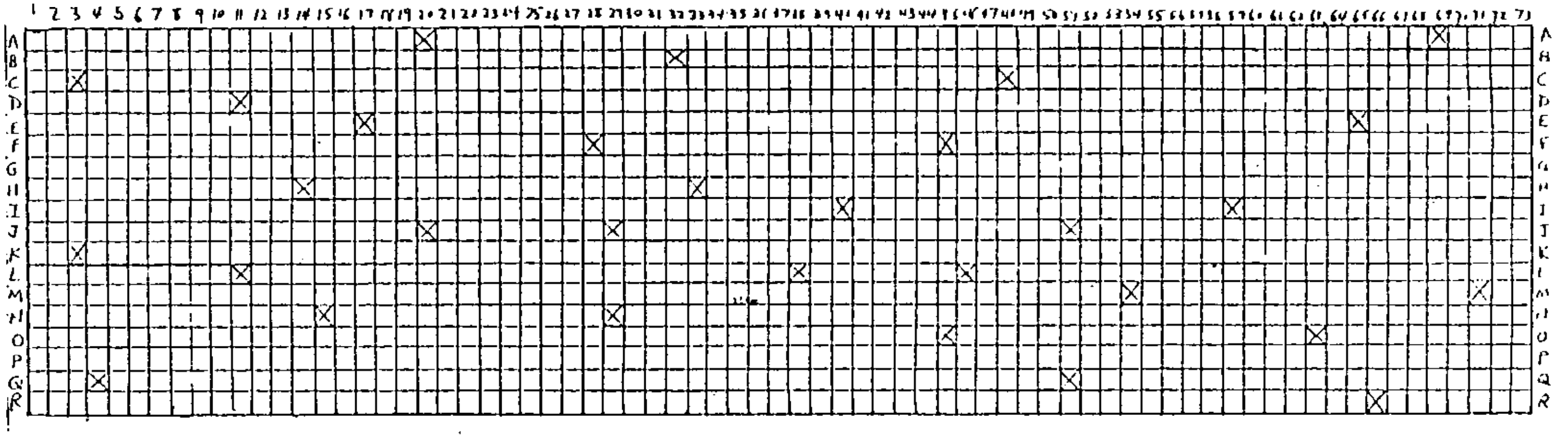


Figure 4-39. Survey Grid Locations, Building 8 Controlled Access Area -- Ceiling

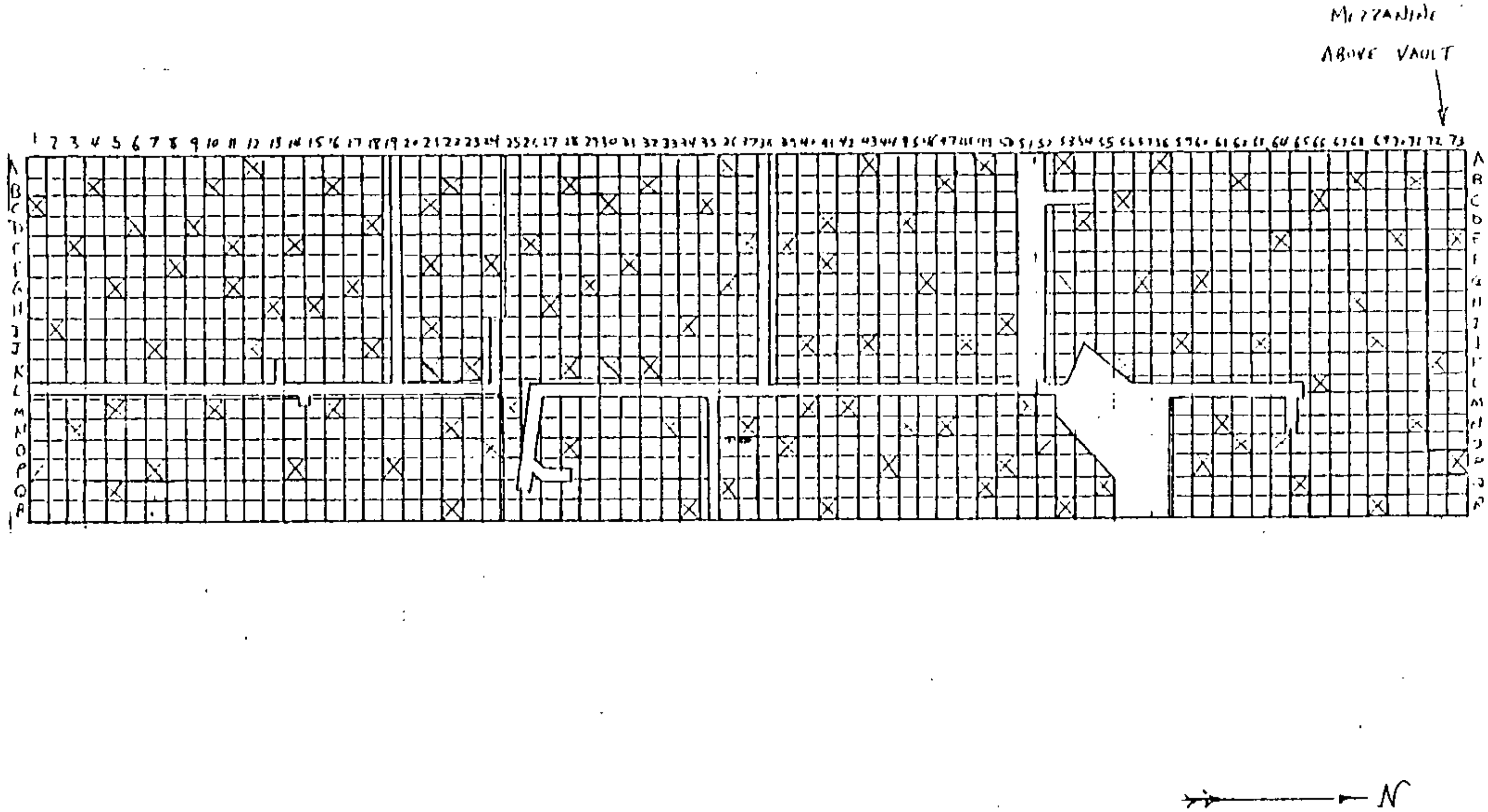


Figure 4-40. Survey Grid Locations, Building 8 Controlled Access Area --
Floor

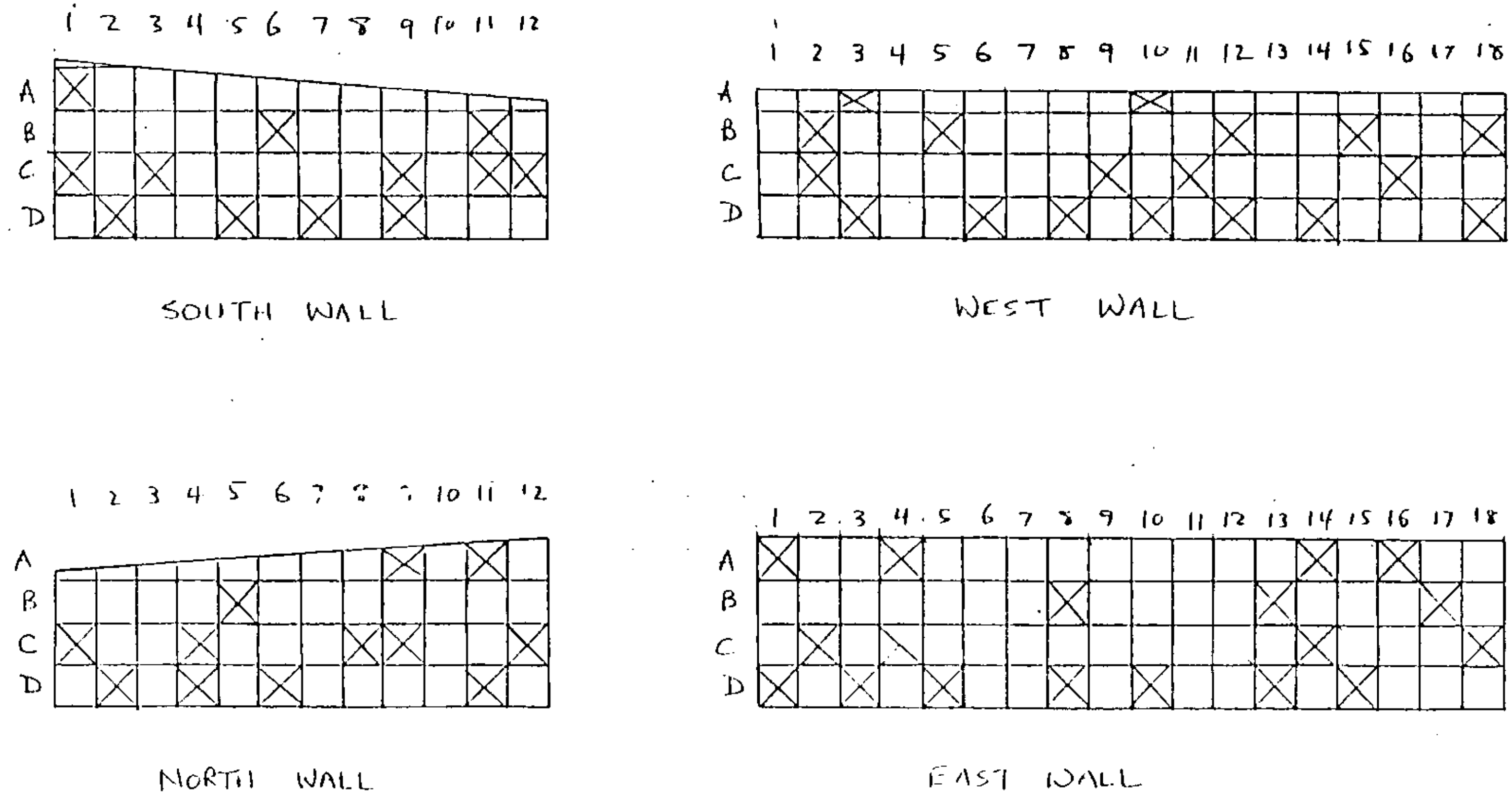


Figure 4-41. Survey Grid Locations, Building 8 Shipping and Receiving -- Walls

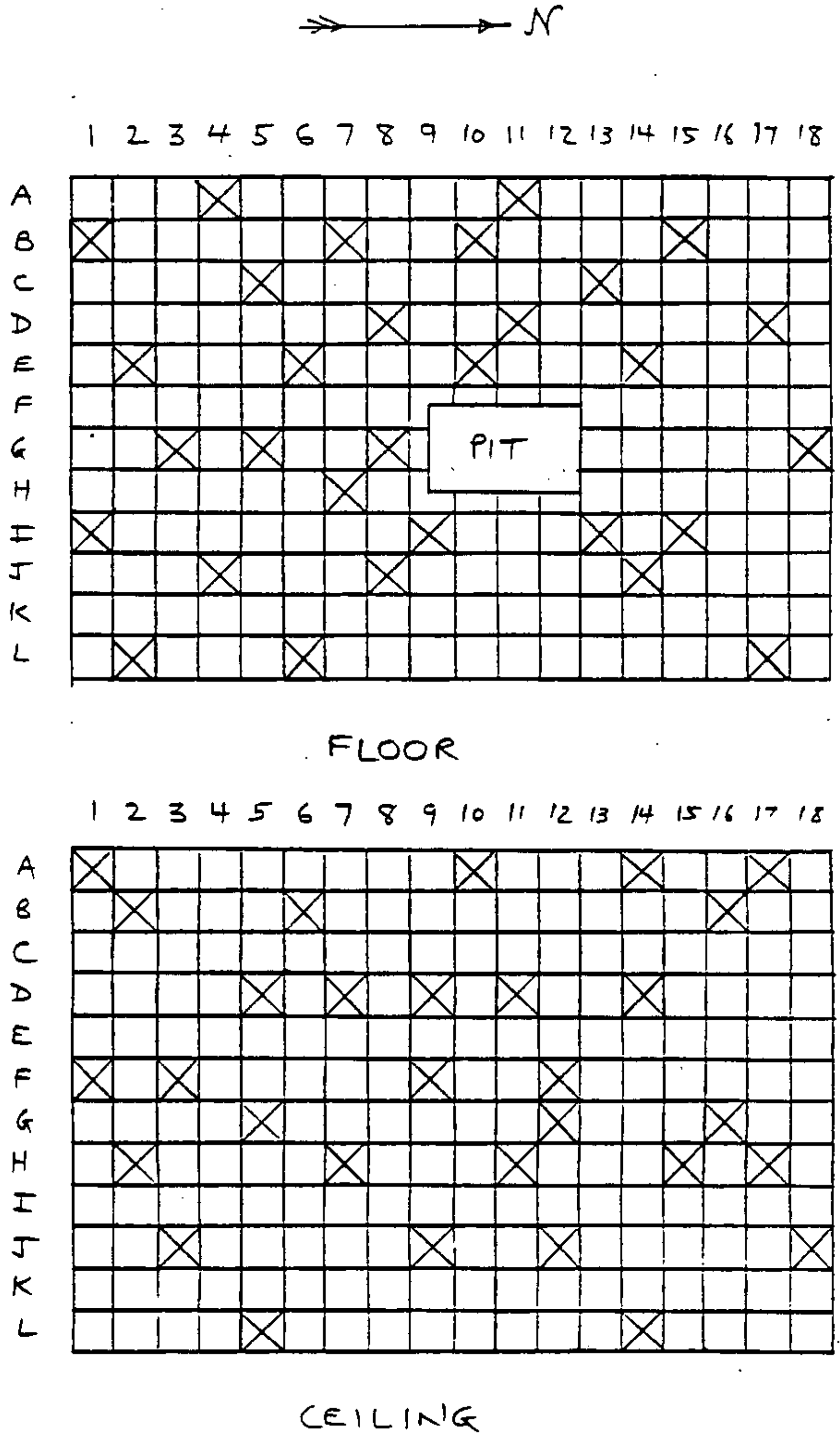


Figure 4-42. Survey Grid Locations, Building 8 Shipping and Receiving -- Ceiling and Floor

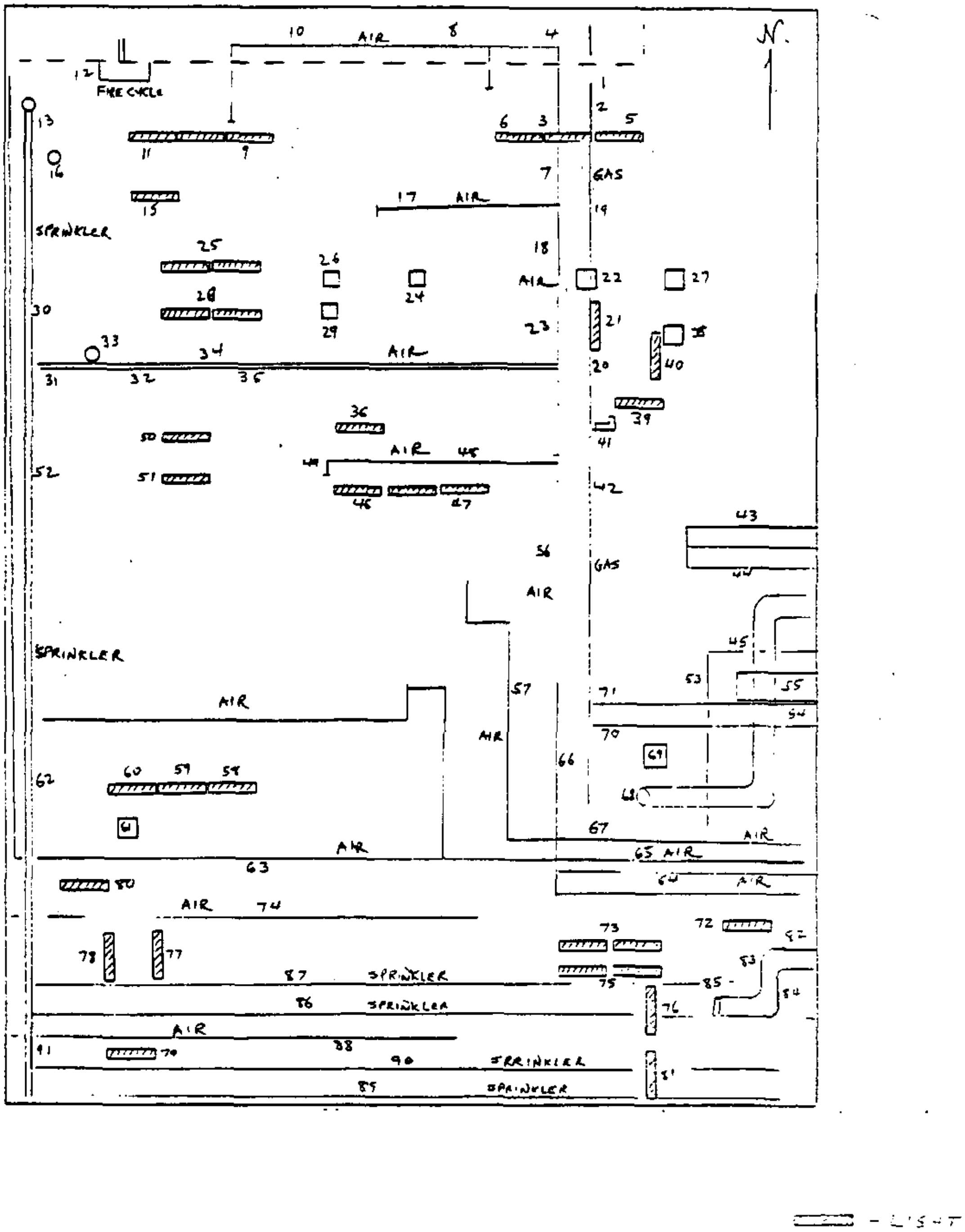


Figure 4-43. PFDL Laboratory Area Miscellaneous Fixtures Layout and Survey Locations

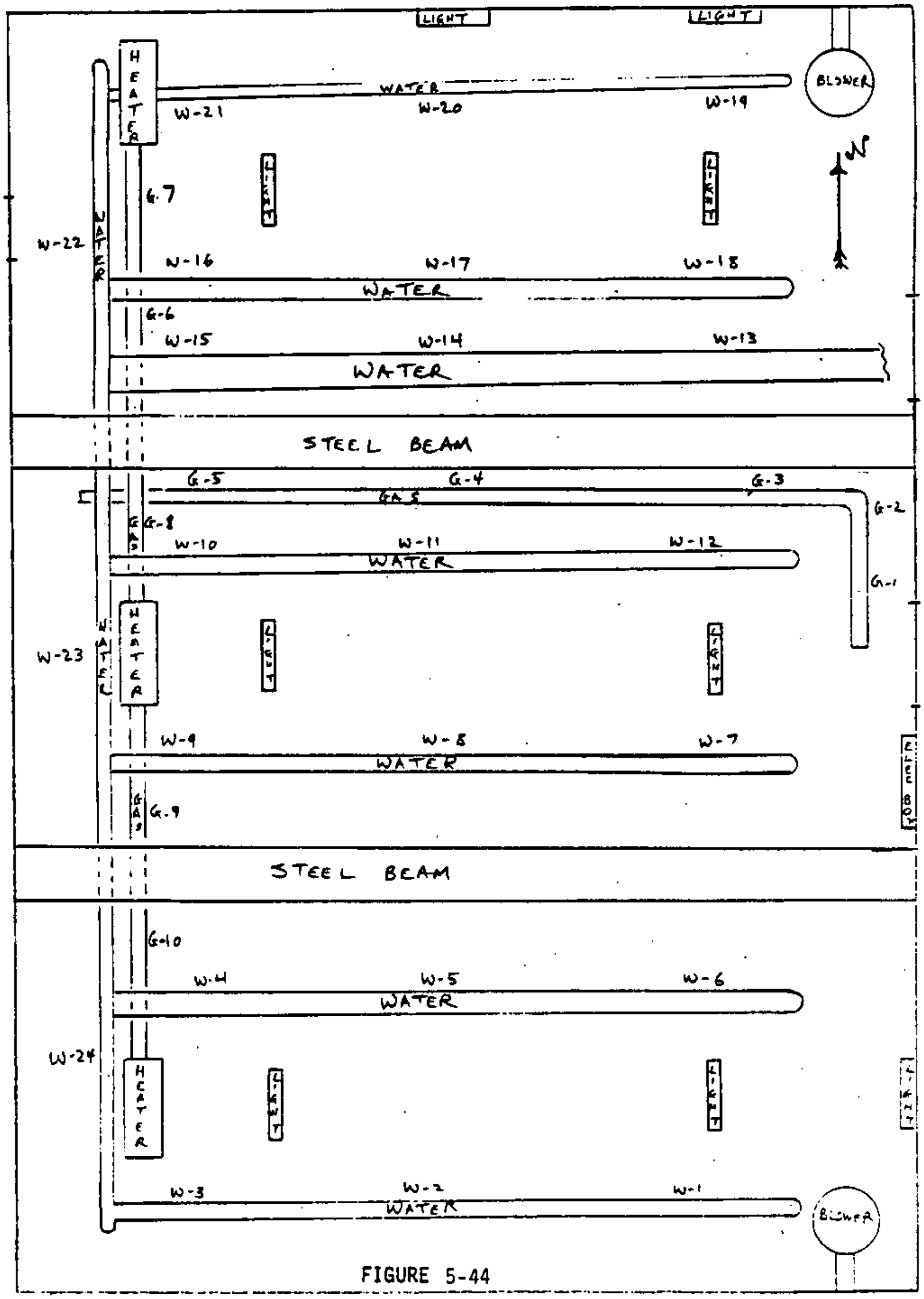


Figure 4-44. PFDL Shipping and Receiving Ceiling Beams and Miscellaneous Fixtures Layout and Survey Locations.

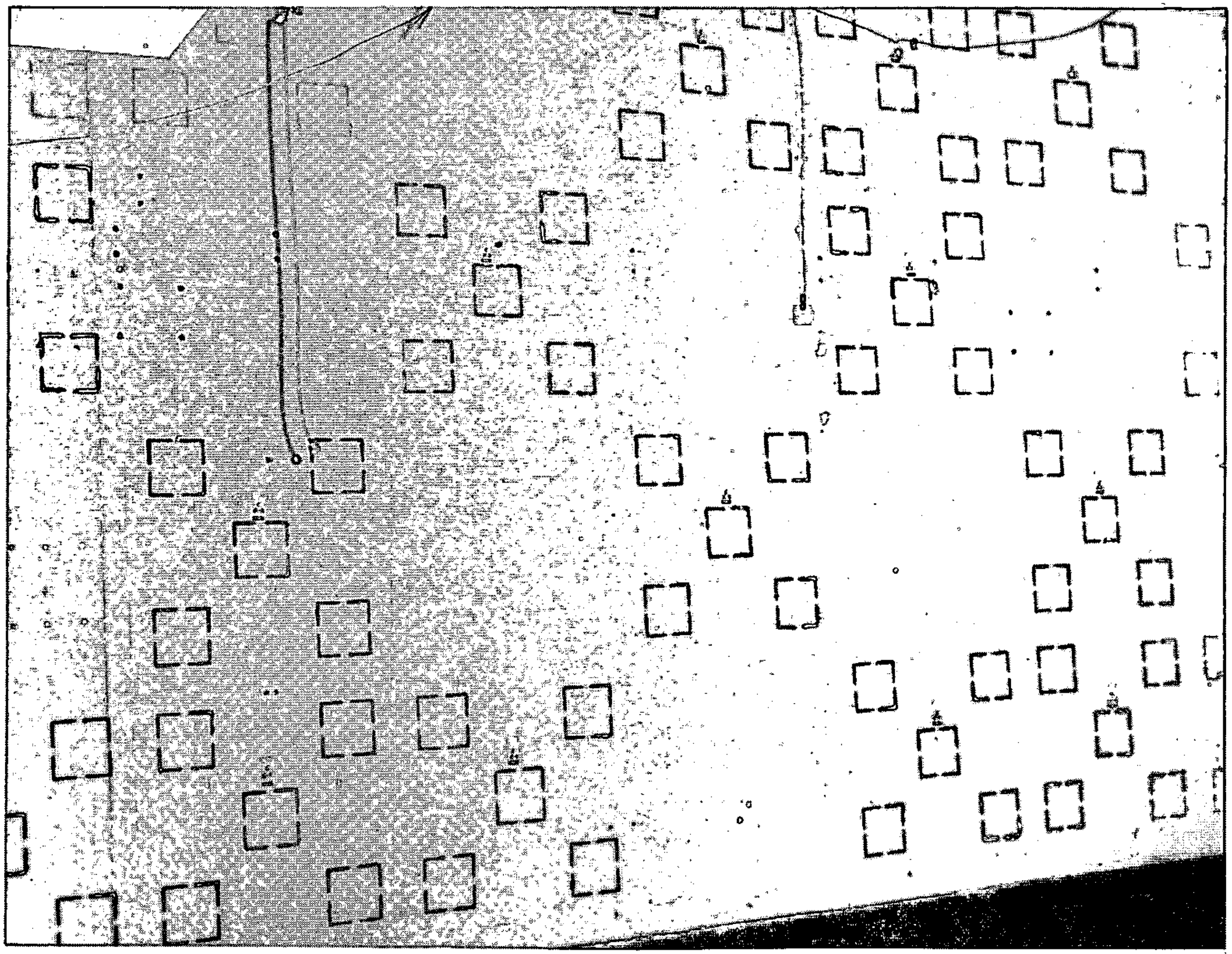


Figure 4-45. Typical Survey Grid Layout on Wall of PFDL Laboratory

TABLE 4-2

SUMMARY OF TYPES OF SURVEY MEASUREMENTS IN PFDL

Measurements Made in Each Selected Grid Location in Controlled Access Area

Type of Measurement	Instrument	Location
Total Alpha	PAC-4G	Whole Grid
Total Beta	HP-190/E-120	Whole Grid
Gamma	Model 19 Micro-R Meter	Whole Grid
Removable Alpha	Smears/LASS-1, SAC-4, H-P	Each Small Square

Measurements Made at Non-Plane Surface Locations
(Structural Supports, Piping, Electrical Equipment)

Type of Measurement	Instrument	Location
Removable Alpha	Smears/LASS-1, SAC-4, H-P	Random Suspect Points
Beta/Gamma	HP-190/Rascal	Holes, Pipes

Measurements Made at Relatively Inaccessible Locations

Type of Measurement	Instrument	Location
Gamma	PG-2/Rascal	Drain Pipes, Soil, Etc.
Beta/Gamma	HP-190/E-120	Rough Surfaces, Irregular Surfaces

4.2 RESULTS OF WESTINGHOUSE SURVEYS OF FACILITY

4.2.1 Preliminary Survey Results

In preparation for the final health physics survey of the facility structures, the following preliminary surveys were performed:

The Analytical Laboratory was completely surveyed as this area was where a release had occurred during laboratory operations; also, extensive dismantling operations of contaminated glove boxes were carried out in this area. As a result of the survey, several contaminated spots were found on the floor, ceiling, and walls. Contaminated floor areas were scarified to remove contamination. Removable walls where contaminated areas were found were packaged as radioactive waste. Contaminated ceiling areas were either removed and packaged as radioactive waste, or were cleaned to acceptable levels.

The instrument analysis area of the Analytical Laboratory was completely surveyed and found to have some contaminated spots on the floor which were scarified.

Several contaminated areas were found on the floor of the Chemical Processing Laboratory and these areas were scarified to remove the contaminated material. A section of the expansion joint area in the floor of the Analytical Laboratory (between grids 24 A-O and 25 A-O) was removed and disposed of as contaminated waste after it showed localized activity above background.

Portions of the floor in the laboratory were scarified in order to remove multiple layers of paint which were resistant to removal with paint stripper.

4.2.2 Final Survey Results

As described in Section 4.1, the final radiation survey was based on a statistical sampling program using a grid network. Cleanup and resurveys were performed for the few areas where slight contamination was found. The sketches showing the grids selected for the final radiation survey are presented in Section 4.1.

The final health physics surveys of gridded areas showed a few additional contaminated areas as follows:

- o The laboratory floor area, grid J-63, initially showed high smear alpha count. However, a repeat of the smear survey showed removable activity within allowable limits.

- o Near floor grids I-21 and K-21, high total alpha counts were observed although no counts above background reading were observed within these grids. The area around floor grids I-21 and K-21 was cleaned and then it was determined that this area was well within limits.

- o Floor grid J-14 in the Shipping and Receiving Area was found to have high total alpha count. This grid was also cleaned and showed no contamination after cleaning.

During the hole survey of the laboratory, twelve holes on the west wall, one hole on the floor, and one hole on the ceiling were found to be above limits. These holes were cleaned and resurveyed and found to be below release limits. For the holes in the walls which were initially found to be contaminated above limits, an enlarged opening was made some 6 inches below and a survey of inner wall surfaces was made to show that there was no contamination within the walls.

Additional holes made 6 inches above the room baseboard to determine contamination between internal and external walls showed that there was no measurable contamination.

In the miscellaneous fixture survey, one fluorescent light and one spot on the plant air supply line in the laboratory were found to be above the smearable alpha count limit. These fixtures were cleaned and resmeared and showed no contamination.

Where liquid monitor waste drain lines were removed from under the floor, soil samples were taken in the bottom of trenches to determine potential plutonium contamination levels in the soil. The results of this soil analyses show that the maximum soil sample contamination was only 2.4 pCi/g, or less than 10 percent of the 25 pCi/g limit for unrestricted release.

In the penthouse, office area, and office auxiliary area (which includes the change room, shower area, and Health Physics office), no contamination was found.

When Oak Ridge Associated Universities (ORAU) and NRC personnel performed their confirmatory survey during the week of December 12, 1983, they found several additional areas which did not meet NRC limits. These areas were primarily confined to the floor of the controlled access area. More specifically, the floor between grids A-25 and A-34 in the S-N direction and grids A-25 and J-28 in the E-W direction was found to be above or near the limits over most of this approximately 100 m^2 area. Hence, this area was scarified to remove excess or questionable activity. Also, the area between grids M-20 and M-25 in the S-N direction and grids M-20 to P-20 in the E-W direction was found to be slightly above limits and was scarified and decontaminated. The area between Grids H-20 and H-23 in the S-N direction and grids H-20 to K-20 in the E-W direction was also found to be slightly above limits and was scarified and decontaminated.

In the Shipping and Receiving Area, grids A1, B5, and J5 on the floor were found to be contaminated above limits and these areas were scarified and decontaminated; immediately adjacent grids as well as the original grids were monitored after decontamination to show that the decontamination process had not spread the radioactive contaminants being removed.

Since the scarifying process removed the original grid markings from these areas, a new grid system was laid out according to Figures 4-46, 4-47, and 4-48.

For the survey conducted after cleaning the "hot spots" identified by ORAU and NRC in their confirmatory surveys during the week of December 12, 1983, Figure 4-46 shows the new grid designations superimposed on the original grid structure (e.g., 99 corresponds to grid A-1, etc.). The Westinghouse confirmatory survey after cleanup corresponds with the new grid designations, and these detailed data may be found in Appendix G.

Figure 4-47 shows an enlarged sketch of the new grid system for the floor of the controlled access area. Figure 4-48 shows where the new grid designations are located relative to the original grid structure. (All grids monitored in the Westinghouse survey at the ORAU/NRC designated hot spot areas are identified in this figure as a dot centered on the original grid system.) These detailed data are included in Appendix G.

The only "hot spots" found in the office and office auxiliary area by the ORAU confirmatory survey was a small spot on the floor of the Mechanical Equipment Room near grid D-13. This grid was easily cleaned to below limits.

4.2.3 Conclusions

The measurements made during the final survey established that the facility met all the required limits to permit release of the building for unrestricted use. These results are summarized in Table 4-3. The raw data are included in Appendix G.

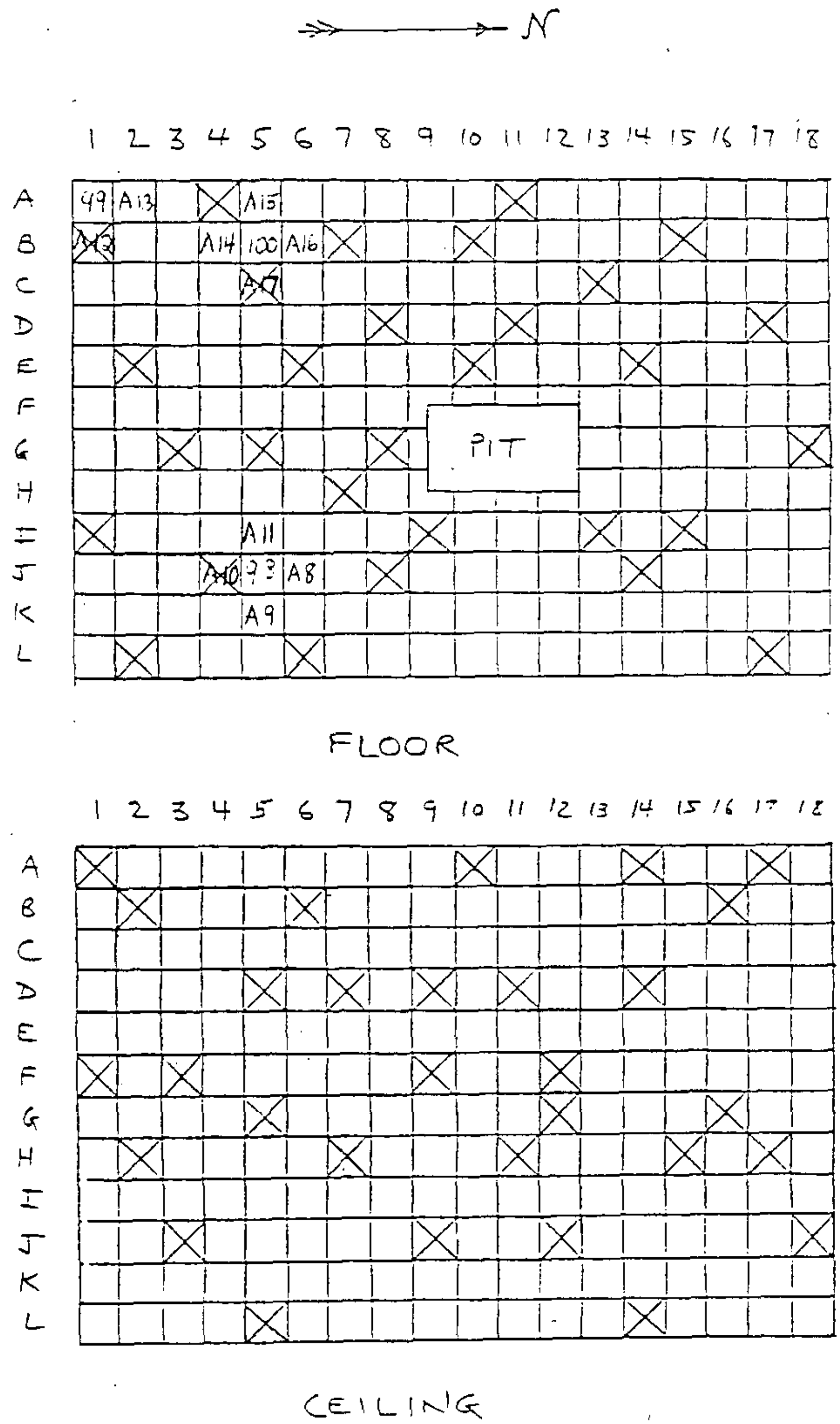
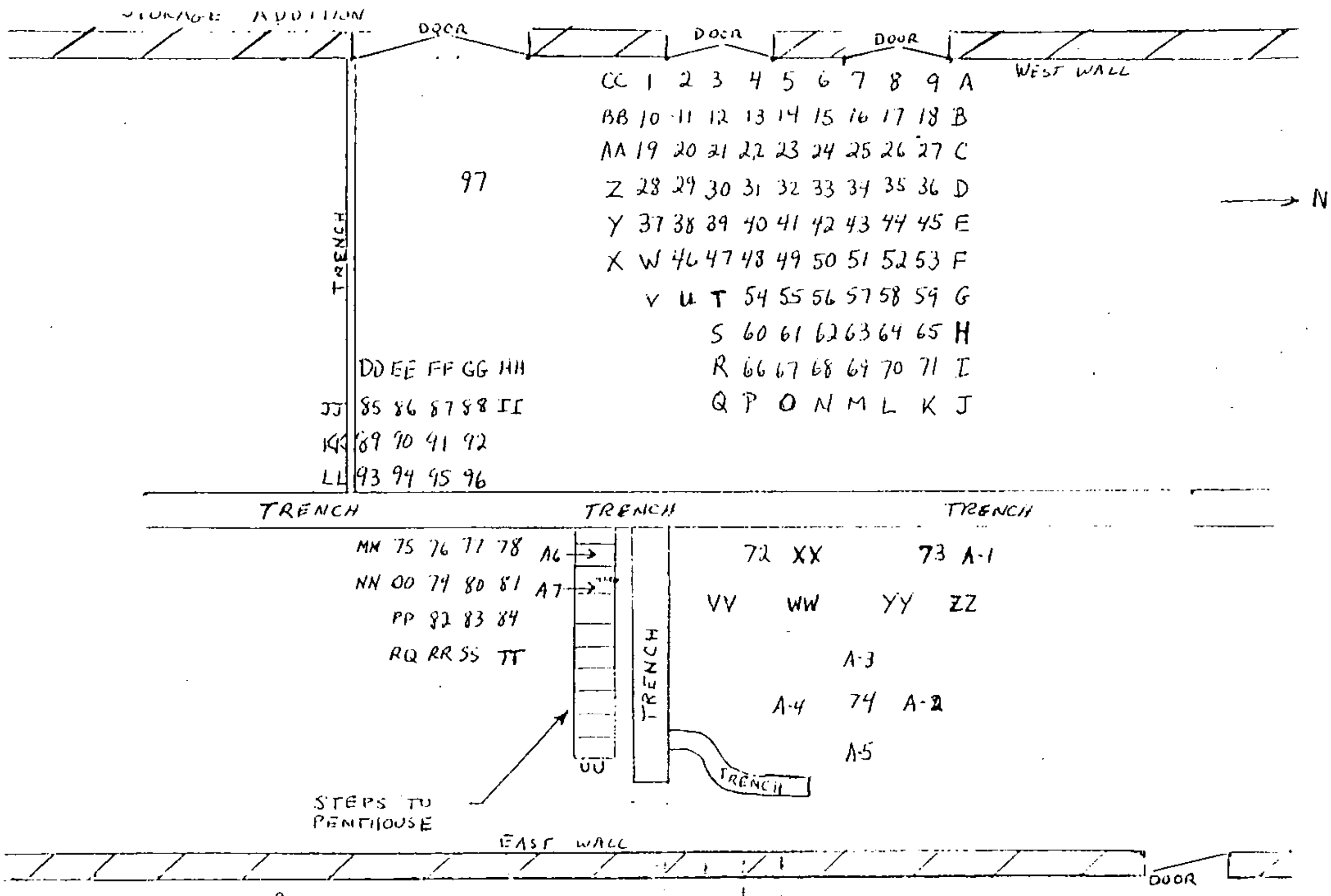
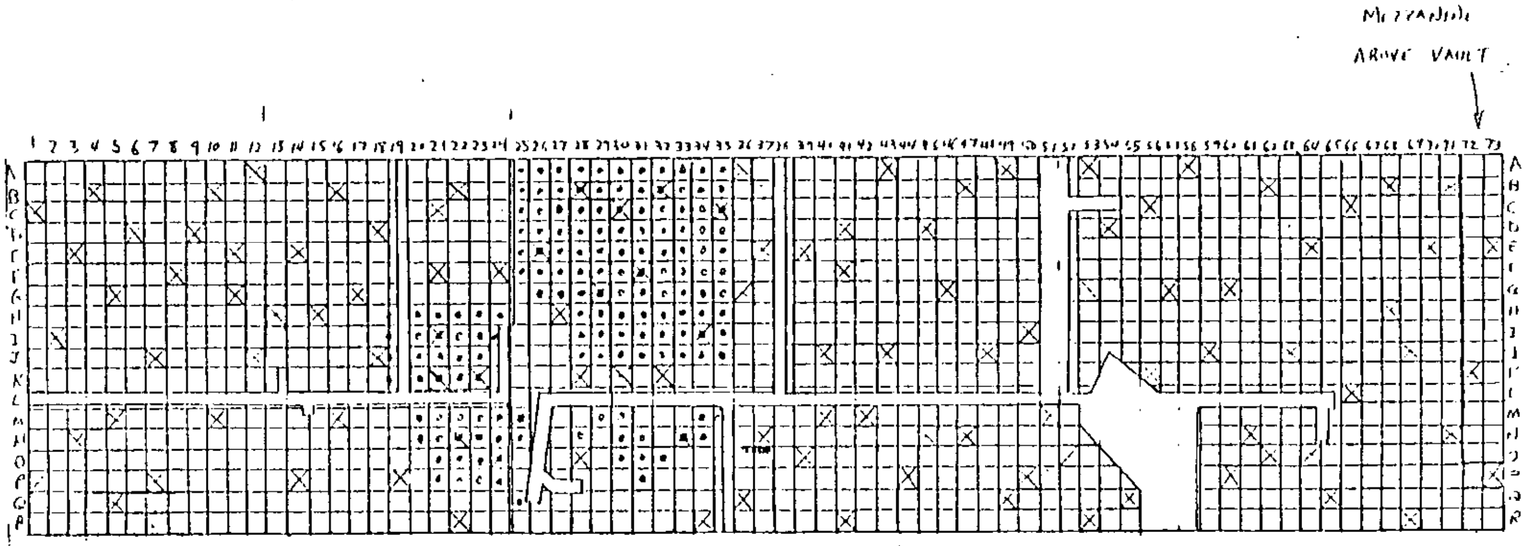


Figure 4-46. PFDL Shipping and Receiving Showing the New Sampling Locations After Scarifying the Floor (Original Sampling Locations Indicated with an "X")



NOTE: Grids = 1 m^2.

Figure 4-47. PFDL Laboratory Showing the New Sampling Locations After Scarifying the Floor



NOTE: Dotted grids show areas which were found to be above NRC guidelines during initial ORAU/NRC confirmatory surveys.

Figure 4-48. PFDL Laboratory Showing the New Sampling Locations After Scarifying the Floor, as Related to the Original Grid Location

TABLE 4-3

SUMMARY OF FINAL SURVEY RESULTS

Measurements Made at Holes on Surfaces

Room	Number of Holes Surveyed	Removable Alpha, dpm/100cm^2	Total Alpha dpm
Lab Area	350	Max = 20	Max = 246
Limits	Maximum	20	250
Minimum Detectable Level (MDL)		3.3	83

Measurements Made at Non-Plane Surfaces
(Structural Supports, Piping, Electrical Conduits, Etc.)

Room	Number of Samples	Removable Alpha, dpm/100 cm^2	Total Alpha, dpm/100 cm^2	Beta/Gamma, μr/hr
Lab Area	172	Max = 12	≤MDL	≤MDL
Limits	Maximum	20	300	500
	Average	Not Applicable	100	100
Minimum Detectable Level (MDL)		3.3	100	10

TABLE 4-3 (cont)

SUMMARY OF FINAL SURVEY RESULTS
OF WALLS, FLOORS AND CEILINGS

Room	Number of Grids Surveyed	Removable Alpha, dpm/200 cm^2	Dose Rate, µr/hr
Office Area	182	Max = 9	$\leq$MDL
Office Auxilary Area	185	Max = 6	$\leq$MDL
Penthouse	91	Max = 6	$\leq$MDL
Limits	Maximum	10	500
	Average	Not Applicable	100
Minimum Detectable Level (MDL)		3.3	10

Room	Number of Grids Selected for Survey	Removable Alpha, dpm/100 cm^2	Total Alpha, dpm/100 cm^2	Total Beta, dpm/100 cm^2	Dose Rate, µr/hr
Lab Area	355	Max = 8	$\leq$MDL	$\leq$MDL	$\leq$MDL
Limits	Maximum	10	300	15,000	500
	Average	Not Applicable	100	5,000	100
Minimum Detectable Level (MDL)		3.3	100	4,000	10

The Westinghouse confirmatory surveys of previously identified "hot spots" showed no residual contamination above NRC unrestricted release limits. The ORAU team also performed a confirmatory survey of these areas on January 17, 1984, and their confirmatory survey of that date showed that the formerly designated "hot spot" areas were clean and the building met all NRC limits for release for unrestricted use. A report of the Oak Ridge Associated Universities independent confirmatory surveys will be published in the near future.

4.3 RADIOACTIVE EFFLUENT EFFECTS ON THE SURROUNDING AREA

4.3.1 Concentrations of Airborne Effluents at Stack Release

All airborne and liquid effluents from License SNM-1120 operations were monitored for radioactivity to establish compliance with NRC regulations for concentrations of radioactive materials in unrestricted areas. For both airborne and liquid effluents, the discharge concentration measurements were made at the point of discharge without allowance for the expected further dilution before the effluent reaches the site boundary. This is conservative, especially when considering that concentrations measured at this point were well below permissible discharge limits without taking credit for dilution at the site boundary.

Concentration levels of gross alpha activity in stack effluents were based on samples collected for one-week periods. Measurements for the PFDL during the last five years (1978 through 1982) show that the annual average concentrations in stack effluents in most cases did not exceed the minimum detectable activity (MDA) levels of the samples (Table 4-4). In no case did the weekly stack samples show activities that exceeded the maximum permissible concentrations for unrestricted areas. The counting system had an MDA level of 2.4×10^{-15} μCi/cc for the weekly stack samples which is equivalent to 4.0 percent of MPC*. The annual average for all stacks was conservatively

* This minimum detectable activity went into effect in June 1979. Prior to this time the MDA was 3.3×10^{-15} which is equivalent to 5.5% of MPC.

TABLE 4-4

SUMMARY OF ANNUAL AVERAGE AIRBORNE STACK EFFLUENT
TOTAL ALPHA RELEASES FOR CALENDAR YEARS 1978-1982 FOR PFDL

Year	Annual Average Stack Effluent Concentration (μCi/ml)	Total Annual Release (μCi)
1978	$\leq 3.3 \times 10^{-15}$	≤ 1.1
1979	$\leq 2.4 \times 10^{-15}$	≤ 0.84
1980	$\leq 2.4 \times 10^{-15}$	≤ 0.87
1981	$\leq 2.5 \times 10^{-15}$	≤ 0.88
1982	$\leq 2.6 \times 10^{-15}$	≤ 0.88

calculated as the time-weighted average of the counting system MDA value for those samples which were equal to or less than MDA plus the time-weighted average for those samples above the MDA.

4.3.2 Off-Site Radiation Exposure Estimates from Airborne Effluents

Off-site airborne environmental air concentration and inhalation dose levels of plutonium discharged from the PFDL were calculated for the years 1978 through 1982 based on measured stack releases and the annual average meteorological dispersion factors (x/Q) and dose models in the Cheswick Site Environmental Report.(4) Dose conversion factors were taken from the EAP analysis of the uranium fuel cycle.(5)

Based on these conditions and the discharge rates described in Section 4.3.1, the maximum dose rate increments to an off-site individual as a result of inhalation of plutonium discharged from the PFDL were calculated as 0.01 mrem/year to the lung if the plutonium were all in an insoluble form and 0.044 mrem/year to the bone if the plutonium were all in a soluble form. Based on the conditions defined above, the total airborne discharge of alpha activity averaged 1.1 μCi/year or less from Building 8 (plutonium plus Am-241). The relatively low values are, most likely, a large overestimate of actual conditions since analysis of stack samples performed in 1975 and presented in Appendix 4.H of the Westinghouse Cheswick Site Fuel Development Laboratories Environmental Report showed that plutonium activity was only about 4 percent of the total alpha activity; and in the present analysis, most of the activity was assumed to be discharged at the minimum detectable level of total alpha activity (2.4×10^{-15} μCi/cc since 1979) as described above.

These data are summarized in Table 4-5. The total dose increment to the lung from all License SNM-1120 operations, assuming that all effluents are in the insoluble form, was calculated to be 0.011 mrem/year. This amounts to only 0.044 percent of the EPA standard(6) for operating fuel fabrication plants and 0.0007 percent of the NRC standard.(7) The total dose increment to the bone, assuming that all effluents are in the soluble form, was calculated to be 0.044 mrem/year. This amounts to only 0.18 percent of the EPA standard(6)

TABLE 4-5

SUMMARY OF AIRBORNE EFFLUENT CONCENTRATION AND MAXIMUM OFF-SITE DOSE RATES VERSUS REGULATORY LIMITS FOR PFDL DURING 1978-1982

Year	Effluent Concentration: Measured at Stack (μCi/ml)	Effluent Concentration: NRC Limit at Site Boundary (μCi/ml)	Dose Rate: Calculated Max. Off Site* (mrem/yr)	Dose Rate: Regulatory Limit: NRC (mrem/yr)	Dose Rate: Regulatory Limit: EPA** (mrem/yr)
1978	$\leq 3.3 \times 10^{-15}$	6.0×10^{-14}	$\leq$0.016 (Lung) $\leq$0.063 (Bone)	1500 3000	25 25
1979	$\leq 2.4 \times 10^{-15}$	6.0×10^{-14}	$\leq$0.010 (Lung) $\leq$0.040 (Bone)	1500 3000	25 25
1980	$\leq 2.4 \times 10^{-15}$	6.0×10^{-14}	$\leq$0.011 (Lung) $\leq$0.044 (Bone)	1500 3000	25 25
1981	$\leq 2.5 \times 10^{-15}$	6.0×10^{-14}	$\leq$0.011 (Lung) $\leq$0.044 (Bone)	1500 3000	25 25
1982	$\leq 2.6 \times 10^{-15}$	6.0×10^{-14}	$\leq$0.011 (Lung) $\leq$0.044 (Bone)	1500 3000	25 25

*Maximum off-site dose rate to nearest off-site individual.

**NRC or EPA limits apply to all activities in the fuel cycle at a given site. However, EPA limits apply only for an operating fuel fabrication facility. Thus, limits given on total dose rate increment for all laboratory releases from the Cheswick Site do not strictly apply but are used for comparison purposes only.

and 0.0015 percent of the NRC standards[7] for the off-site environment. These dose rates are so low that they require no further discussion.

4.3.3 Concentrations of Liquid Effluents at Release

Off-site radiation exposures were also possible as a result of liquid effluents discharged through the sanitary sewer system. Such releases were permitted only after the analysis of the contents of suspect liquids in quarantine tanks showed that the activity levels were below maximum permissible concentration levels according to NRC Regulation 10 CFR 20.303.[7]

Summaries of the annual activity and volumes of suspect waste discharged from Building 8 are presented in Table 4-6 for the years 1975 through 1982. All activity less than the minimum detectable level has been considered to be at this level. Thus, in cases where this makes a significant fraction of the total, discharges are listed as equal to or less than the average value. In the fifth column of Table 4-6, the annual average alpha concentration discharged to the sanitary sewer generally decreased from 1.7 percent in 1975 to less than 0.37 percent for 1981 and 1982. Thus, the liquid discharge concentration as well as total annual alpha activity discharge was consistently lower during decommissioning and decontamination (1979-1982) than it was during process development operations (1975-1978).

4.3.4 Off-Site Radiation Exposure Estimates from Liquid Effluent Releases

Large dilution factors result from mixing suspect waste discharges with nonradioactive sanitary waste water from the entire Cheswick Site. This nonradioactive waste water averaged 50,000 gallons per day, which thoroughly mixed with the suspect waste from License SNM-1120 operations prior to being processed by the Allegheny Valley Joint Sewage Authority, and was further diluted as it entered the Allegheny River by an assumed average flow rate of 12.1 billion gallons per day.

TABLE 4-6

EVALUATION OF ALPHA CONCENTRATION LEVELS IN LIQUID EFFLUENTS DISCHARGED FROM PFDL (1975-1982)

Discharge Period (Calendar Year)	Total Volume of Suspect Waste (Gallons)	Total Annual α Activity Discharged (μCi)	Annual Average α Concentration Discharged to Sanitary Sewer (μCi/ml)	Annual Average α Concentration Discharged to Sanitary Sewer (% of MPC)*	Annual Average α Concentration in Sanitary Sewer (% of MPC)*	Annual Average α Concentration in Allegheny River (% of MPC)**
1975	3.80E+04†	1.6 E+02	1.1 E-06	1.7	3.7 E-03	3.7 E-07
1976	1.97 E+04	≤2.7 E+01	≤3.6 E-07	≤0.56	≤6.0 E-04	≤6.2 E-08
1977	2.55 E+04	≤4.7 E+01	≤4.9 E-07	≤0.75	≤1.0 E-03	≤1.1 E-07
1978	3.79 E+04	≤4.0 E+01	≤2.8 E-07	≤0.43	≤8.9 E-04	≤9.1 E-08
1979	2.47 E+04	≤2.3 E+01	≤2.4 E-07	≤0.37	≤5.0 E-04	≤5.1 E-08
1980	1.33 E+04	≤2.5 E+01	≤5.0 E-07	≤0.77	≤5.6 E-04	≤5.7 E-08
1981	3.02 E+04	<2.7 E+01	<2.4 E-07	<0.37	<6.1 E-04	<6.3 E-08
1982	4.01 E+04	<3.6 E+01	<2.4 E-07	<0.37	<8.0 E-04	<8.3 E-08

*MPC = The maximum permissible concentration for soluble plutonium isotopes in sanitary sewer systems (including allowance for beta activity in the plutonium mixture) according to 10 CFR 20, Appendix B, Table I [4] = 6.5×10^{-5} μCi/cc.

**MPC = The maximum permissible concentration of soluble plutonium isotopes in effluents to unrestricted areas (including allowance for beta activity in the plutonium mixture) according to 10 CFR 20, Appendix B, Table I [4] = 2.6×10^{-6}.

†3.80 E+04 = 3.80×10^4, etc.

To show the effectiveness of this dilution process, Columns 5, 6, and 7 of Table 4-6 present the calculated concentration in percentage of MPC discharged to the sanitary sewer (Column 5), the average concentration in percentage of MPC after mixing with nonradioactive Cheswick Site waste water (Column 6), and average concentration in percentage of MPC after complete mixing of the sanitary sewer containing suspect waste in the Allegheny River (Column 7). These data show that the annual average effluent discharge for 1982 was less than 0.37 percent of maximum permissible concentration; and after mixing with the other nonradioactive waste water leaving the site, the annual concentration was reduced to the order of 1/1,000 of 1 percent of the MPC. After complete mixing in the river, the diluted suspected waste for 1982 was less than one-tenth of a millionth of 1 percent (10^{-7}) of the MPC. Because of these large dilution factors and because of the relatively low absorption of plutonium and uranium through the ingestion process, it is extremely unlikely that plutonium and uranium ingested by humans via the aquatic pathway (e.g., downstream drinking water or fish) could result in doses that are more than a fraction of a percent of the maximum permissible values. The calculated plutonium concentration values in the river for 1982 showed relative values of about 30 percent higher than the previous year, but about 30 percent lower than for 1977. These values are so low that relative increases or decreases of this magnitude are insignificant with respect to existing environmental levels.

SECTION 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

Decontamination of a plutonium fabrication facility can be accomplished in a safe, systematic manner without undue difficulty. The operation must be planned in detail and a dedicated staff assigned for the duration of the effort. Planning must be updated on a regular basis, and personnel must be adequately trained and rehearsed for all operations. All personnel should participate in the detailed planning in order to make use of the employees' knowledge of the day-to-day operations.

Operations can be planned to ensure a smooth flow of work by establishing groups with assigned responsibilities, and maintaining the group makeup for the duration of that specific effort. The overall work plan should be organized on normal industrial production flow principles with a logical sequence of operations.

Adequately sized support groups of trained craftworkers and health/safety technicians are necessary. Separate personnel should be identified to maintain records, particularly in the waste handling and shipment functions. Operations must be closely monitored by engineers and foremen. Once the flow is established, decontamination and dismantling will proceed analogously to a production job-shop-type operation.

5.2 RECOMMENDATIONS FOR DECONTAMINATION AND DECOMMISSIONING OF AN EXISTING FACILITY

The recommended procedures which were developed before and during the decontamination and decommissioning operations are described in Section 2 and in Appendixes B and H. A critique of the operations indicated the following items which would be given further consideration and possibly performed differently if this operation were to be done again:

1. Removal of liquid transfer lines (see Section 2.3) could have been performed in a more efficient manner by the following:

   a. Liquids were transferred by means of an in-house dedicated vacuum system. This system was disconnected near the beginning of the facility decontamination prior to start of removal of transfer piping. If this system had remained in place, it could have been used while piping was being cut to minimize liquid escaping from the lines and to provide an air back-flow which would have acted to dry the lines and reduce air-borne contamination.

   b. Serious consideration should be given to drying the liquid transfer lines prior to cutting by forcing heated air through the lines. Handling of air-borne contamination vs. liquid contamination is the critical determinant for this decision.

   c. Flush lines more thoroughly. Although two acid flushes followed by two water flushes were performed at the PFDL, alpha contamination levels of solution remaining in the lines were still very high.

2. The heavy-walled solution handling and storage tanks were cut into sections using saws. Flame cutting (specifically plasma arc) had been investigated but ruled out for two reasons: 1) safety provisions would have required strictly controlled operations at a prepared location, which would have required moving equipment to the location, thus negating much of the potential benefit; and 2) large quantities of smoke in a confined volume was a problem which could be solved only by using an inert gas atmosphere*. It was determined that the type of operation to be performed would not benefit from the use of flame cutting. In retrospect, after cutting the four large solution holding tanks in Glove Box No. 241 (see Section 2.8), it may have been worthwhile to employ flame cutting for this one operation.

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* Private communication with another corporation performing similar work.

3. During glove box decontamination operations, the liquid cleaning solution was either collected and solidified in cement for disposal, or allowed to remain in the glove box in trays and allowed to evaporate. These procedures were time consuming and, in the case of solidification, expensive. It is recommended that forced evaporation be considered to at least reduce the volume of liquid and the resultant volume of cement, or completely evaporate the liquid. A portable evaporator could be utilized in the glove box being cleaned, or a central facility could be installed.

4. All personnel should be thoroughly familiar with the operation of the glove box and exhaust ventilation systems and requirements for maintenance of air flow during dismantling of glove boxes and facilities. This would have reduced or eliminated several occurrences of recontamination of previously cleaned glove boxes.

5. Much effort was expended stripping the epoxy paint from floors in the laboratory. It would have been more cost effective and would have resulted in less contaminated waste if the entire floor had been scarified, particularly in view of the additional scarification that was required in the wet processing areas to remove embedded contamination. The original concern for airborne contamination caused by scarifying dusting, which we could not effectively control with a portable vacuum enclosure, was alleviated by the development of a procedure which utilized a fine spray of water to dampen the surface being scarified. The resultant slurry was swept while still damp, and the surface was then vacuumed with a HEPA filtered vacuum cleaner.

5.3 RECOMMENDATIONS FOR DESIGN OF NEW FACILITIES

Based upon decontamination and dismantling of this facility, the following recommendations are made for equipment and facility design which would facilitate future decontamination and dismantling of similar facilities.

5.3.1 Glove Boxes and Equipment

1. The use of fume hoods for handling small quantities of plutonium is not recommended; glove boxes are preferable. If fume hoolds are used, they should be of all-stainless-steel construction. The installation should allow for access around all sides of the hoods.

2. All portions of a glove box should be visible without having to use mirrors.

3. Sufficient glove parts should be installed in glove boxes to provide hand access to all portions of the box. If this is not possible, extension devices should be designed and provided prior to committing a box to operations.

4. Adequately sized ports should be provided in each glove box, or alternate glove boxes, in order to remove components, rather than relying on only one larger port in a glove box line. This will reduce difficult transfers of large equipment through a series of glove boxes.

5. Many of the glove boxes in PFDL were designed with windows 4 feet by 9 feet; these were difficult to handle. When the glove boxes were sectioned for packaging, the large windows required cutting through the gaskets, which resulted in the release of contamination in the dismantling facility. Window sizes of 4 feet square are recommended. This size can be handled and packaged without cutting through the gaskets.

6. Glove box designs should include provisions in the ceiling for attaching hoists or other lifting devices on the inside in order to lift heavy equipment located in the glove box.

7. Glove box systems should be designed with dual parallel filters, in bag-out type housings, outside the glove boxes. The installation should be designed so that each filter can be isolated during filter changes so that exhaust air never bypasses a filter.

8. Air locks are extremely useful for introducing supplies and equipment into a glove box. Each line of glove boxes should contain at least one air lock.

9. In order to aid in dismantling or repair, all custom equipment for use in glove boxes should be designed with stainless steel Allen head screws; hex head and slotted fasteners should be avoided. Allen wrenches are more easily manipulated remotely or with extensions, and are easier to handle with heavy gloves, than hex-head wrenches and screwdrivers. Allen wrenches also provide a more positive grip with the fastener. Stainless steel resists corrosion; Allen head screws should not be painted, as the wrench may then not fit. Where possible in purchased equipment, hex head and slotted screws should be replaced with Allen head screws; particular attention should be directed to major disassembly points such as motor mounts, enclosures, and support structures.

10. All heavy equipment located in a glove box should either be sealed around the base plate to prevent contamination underneath or should be mounted on spacers to permit cleaning underneath.

11. Mechanisms which are designed for use in glove boxes, or in other contaminated environments, should be assembled with mechanical fasteners, where possible, to facilitate dismantling; welding should be avoided. Size of individual components should be kept small to permit packaging. A good rule-of-thumb is to size components so that they can be fitted into a 55 gallon drum with allowance for packaging.

12. At the time of installation, larger pieces of equipment such as tanks, base plates, and motors, which are located in glove boxes, should be provided with lifting lugs or holes. Mount lifting lugs at several locations along the length of the tanks to support and lift sections when the tanks are being dismantled.

13. Equipment installed in glove boxes should be located far enough from windows and walls to provide accessibility; a clearance distance of approximately 12 inches is suggested.

14. Hydraulic systems, pumps, and other equipment servicing glove boxes, which are located outside of the glove boxes, should be isolated from the room in order to contain leaks.

5.3.2 Contaminated Liquid Waste Handling Systems

1. The use of Raschig rings for criticality control in large solution tanks is not recommended. Disposal of the rings, and sectioning and disposal of the large tanks, involved an extensive effort and generated considerable waste. Critically safe tanks (approximately 5 inches diameter) are recommended for ease of handling and disposal.

2. Use of gravity drains on solution tanks should be avoided for routine operations. If a valve should fail, there may be no way to prevent a tank from accidentally emptying. A pump transfer system should be used for transferring liquid out of the tanks.

3. Install all liquid transfer lines on a slope so that they will drain by gravity and there will be no low spots.

5.3.3 Air Handling Filters

1. Disposal of larger whole contaminated filters is a problem because of size; we had many filters 2-feet square by 1-foot thick which required very inefficient packaging. Design of filter systems should incorporate smaller filters, where possible, that can be fitted into a 55 gallon drum. An alternate approach is to provide a filter disassembly or compacting installation independent of the main exhaust filter systems so that all, or most, of the large filters can be efficiently disposed of.

2. The use of multiple filter housings for larger filters should be avoided. The use of individual filter housings, or sectional housings, facilitates dismantling of the housings.

5.3.4 Liquid Waste Monitoring System

1. Liquid waste monitor drain lines should be accessible over their entire length, either in walls or in a floor trench. They should not be buried under the floor.

2. Holding tanks for liquid waste monitor drains should be located within a pit for accessibility rather than buried underground.

5.3.5 Facility

1. Utility supply lines, such as air, gas and water should be installed with shutoff valves at each service connection and at each tee in the line to provide for isolation.

2. When designing a facility and installing equipment, adequate working room around pipes and ducts should be provided.

3. All doors in the facility should be of sufficient size to permit movement of the largest piece of equipment, or easily removable wall panels should be utilized.

4. At least two personnel emergency decontamination rooms should be provided, each with a capacity for several people.

5. Glove boxes should be installed so that access to all sides is available; they should not be placed againt walls. Adequate space should be allowed between glove box lines, and around other equipment, for passage of fork trucks and any other heavy equipment which might be required during operations or dismantling.

6. We considered the plastered interior walls and ceilings of the facility to be ideal for contamination control barriers (when painted); provisions should have been made in the ceiling for heavy lifting lugs fixed to the structure above the ceiling.

7. All interior building surfaces should be painted prior to committing a facility to handling of contaminated materials. The paint should be of a distinctive color, and records of repainting should be maintained to aid in the decontamination paint stripping. Avoid epoxy-based paints since they are very difficult to strip.

SECTION 6

REFERENCES

1. Adams, G. A., et al, "Decontamination and Decommissioning," DOE/37247/1, Westinghouse Electric Corporation Advanced Reactors Division, February 1982.

2. ANSI N13.12, "Control of Radioactive Surface Contamination on Materials, Equipment and Facilities to be Released for Unrestricted Use," American National Standard Institute, August 1978 (Draft).

3. NUREG/CR-2082, "Monitoring for Compliance with Decommissioning Termination Survey Criteria," Prepared for U.S. Nuclear Regulatory Commission by Oak Ridge National Laboratory, June 1981.

4. Westinghouse Cheswick Site Fuel Development Laboratories Environmental Report, Nuclear Fuel Division, Advanced Reactors Division, Rev. 3, September 1975.

5. Environmental Analysis of the Uranium Fuel Cycle, Part I - Fuel Supply, EAP-520/9-73-003B, U.S. Environmental Protection Agency, Office of Radiation Programs, October 1973.

6. Title 40, Chapter 1, Code of Federal Regulations, Part 190, Environmental Protection Standards for Nuclear Power Operations, U.S. Environmental Protection Agency, Federal Reporter, Volume 42, No. 9, Thursday, January 13, 1977.

7. Title 10, Chapter 1, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation," U.S. Nuclear Regulatory Commission.

APPENDIX A

CONTAMINATED EQUIPMENT CONTAINED IN THE PFDL FACILITY

CONTAMINATED EQUIPMENT SUMMARY

	Volume cu.ft.
GLOVE BOXES	
Analytical Laboratory	1,011
Chemical Development Laboratory	502
Chemical Process Laboratory	3,004
Ceramics Laboratory	2,966
Welding Laboratory	146
Metallography Laboratory	216
North Laboratory	192
Total	8,037
HOODS	
Analytical Laboratory	794
Chemical Development Laboratory	99
Total	893
FILTER BANKS	
Analytical Laboratory	99
Penthouse	1,962
Total	2,061
CHEMICAL PROCESS TANKS AND COLUMNS	
Steel Tanks	202
Glass Columns	3
Total	205
DUCT	
Analytical Laboratory	231
Chemical Development Laboratory	106
Chemical Process Laboratory	143
Ceramics Laboratory	203
Welding Laboratory	46
Metallography Laboratory	8
North Laboratory	14
Instrument Laboratory	23
Penthouse	738
Total	1,512
EQUIPMENT	1,652
TOTAL VOLUME	14,360 cu.ft.*

*Of this total, 738 cu.ft. was contaminted with uranium only.

GLOVE BOXES

Glove Box Number	Glove Box Size (Inches) LxWxH	Volume Ft^3	Remarks
101	84 x 44 x 42	111.2	
102	84 x 44 x 52	111.2	
121	84 x 44 x 52	111.2	
122	84 x 44 x 52	111.2	
134	84 x 44 x 52	111.2	
120	27 x 19 x 52	15.4	
151	84 x 42 x 52 24 x 21 x 24	107.4 7.0	Box 151 is L-Shaped - 2 Sections
152	84 x 44 x 52	111.2	
152A	48 x 43 x 48	57.3	
153	84 x 44 x 52	111.2	
161	49 x 30 x 53	45.1	
201	132 x 48 x 96	352.0	
201A	51 x 37 x 126	137.6	
202	86 x 30 x 57	67.3	Includes Air Lock (18 x 18 x 12)
211	117 x 42 x 64	182.0	Includes Air Lock (18 x 18 x 12)
212	84 x 42 x 64	130.7	
213	48 x 42 x 66	77.0	
221	117 x 41 x 58	161.0	Includes Air Lock (18 x 18 x 12)
222	96 x 41 x 58	132.1	
223	96 x 41 x 58	132.1	
231	120 x 48 x 76	253.3	
232	47 x 48 x 75	97.9	
233	84 x 48 x 76	177.3	
233A	169 x 48 x 33	154.9	
234	66 x 48 x 76	139.3	Includes Air Lock (18 x 18 x 12)
241	150 x 52 x 117	528.1	
242	68 x 48 x 149	281.4	

CONTINUED

GLOVE BOXES (CONTINUED)

Glove Box Number	Glove Box Size (Inches) LxWxH	Volume Ft^3	Remarks
Waste Load Out Box	34 x 34 x 67	44.8	
301	47 x 42 x 96	109.7	
302	95 x 41 x 58	130.7	
303	95 x 41 x 58	130.7	
304	95 x 41 x 58	130.7	
305	95 x 41 x 58	130.7	
305A	58 x 52 x 26	45.4	
400	88 x 44 x 83	186.0	
401	102 x 43 x 71	180.2	
402	101 x 43 x 59	148.3	
403	118 x 43 x 59	173.2	Includes Air Lock (18 x 18 x 12)
404	108 x 32 x 138	276.0	Includes Air Lock (24 x 24 x 24)
411	42 x 42 x 69	70.4	
412	141 x 41 x 67	224.1	
414	206 x 24 x 34	97.3	
415	58 x 28 x 31 75 x 46 x 47	29.1 93.8	Box 415 is 2 Sections Bolted Together
416	93 x 42 x 30	67.8	
417	98 x 43 x 59	143.8	
418	42 x 44 x 53 43 x 44 x 61	56.6 66.7	Box 418 is 2 Sections Bolted Together
420	111 x 52 x 58 34 x 38 x 19	193.7 14.2	Box 420 is L-Shaped Measured Separately Sections Welded Together
421	101 x 44 x 60	154.3	
422	95 x 42 x 58	133.9	
423	95 x 42 x 58	133.9	
424	95 x 47 x 57	147.3	
425	73 x 50 x 38 89 x 42 x 35 80 x 39 x 24	80.3 75.7 43.3	Box 425 is 3 Sections Bolted Together

CONTINUED

GLOVE BOXES (CONTINUED)

Glove Box Number	Glove Box Size (Inches) LxWxH	Volume Ft^3	Remarks
501-502	72 x 30 x 46	57.5	
503	34 x 41 x 41	33.0	Box is 2 Sections Bolted Together
	37 x 44 x 59	55.6	
601	48 x 41 x 59	67.2	
602	96 x 41 x 59	134.4	
603	35 x 19 x 17	6.5	
604	42 x 19 x 17	7.8	
701	88 x 38 x 62	120.0	
702	83 x 25 x 60	72.0	

FUME HOODS

Hood Number	Hood Size (Inches) LxWxH	Volume Ft^3	Remarks
1-2	97 x 37 x 70	145.4	
3	48 x 36 x 70	71.9	
4	48 x 37 x 70	71.9	
5	48 x 37 x 70	71.9	
6	48 x 37 x 70	71.9	
7	48 x 37 x 70	71.9	
9-10	97 x 37 x 70	145.4	
11	48 x 37 x 70	71.9	
351-352	96 x 35 x 51	99.2	Uranium Contamination Only
8	48 x 37 x 70	71.9	

FILTER BANKS IN ANALYTICAL LABORATORY

Identification	Size (Inches) L x W x H	Volume Ft^3
Caisson Model C-1	24 x 34 x 30	14.2
Caisson Model C-1	24 x 34 x 30	14.2
Caisson Model C-1	24 x 34 x 30	14.2
Caisson Model C-1	24 x 34 x 30	14.2
Caisson Model C-1	24 x 34 x 30	14.2
Caisson Model C-1	24 x 34 x 30	14.2
Caisson Model C-1	24 x 34 x 30	14.2

FILTER BANKS IN PENTHOUSE

Filter Bank Number	Size (Inches) LxWxH	Volume Ft^3	Remarks
F-51	128 x 34 x 50	126	Laboratory Room Systems
	128 x 34 x 50	126	
F-52	128 x 34 x 50	126	Laboratory Room Systems
	128 x 34 x 50	126	
F-53	128 x 34 x 50	126	Laboratory Room Systems
	128 x 34 x 50	126	
F-54	128 x 34 x 50	126	Laboratory Room Systems
	128 x 34 x 50	126	
F-55	97 x 34 x 44	84	Process Glove Box System
	97 x 34 x 44	84	
F-56	97 x 34 x 44	84	Process Glove Box System
	97 x 34 x 44	84	
F-57	34 x 24 x 30	14.2	Laboratory Room Systems
	34 x 24 x 30	14.2	
	34 x 24 x 30	14.2	
	34 x 24 x 30	14.2	
F-58	34 x 24 x 30	14.2	Laboratory Room Systems
	34 x 24 x 30	14.2	
	34 x 24 x 30	14.2	
	34 x 24 x 30	14.2	
F-59	128 x 34 x 50	126	Analytical Laboratory System
	128 x 34 x 50	126	
F-60	128 x 34 x 50	126	Analytical Laboratory System
	128 x 34 x 50	126	

DUCT

Laboratory Area	Size	Length	Type	Ft^3
North Lab	6" Dia.	70 Ft.	Metal	13.7
Met Lab	6" Dia.	40 Ft.	Metal	7.8
Weld Lab	6" Dia.	20 Ft.	Metal	3.9
	8" Dia.	16 Ft.	Metal	5.6
	12" Dia.	40 Ft.	Metal	31.4
	14" Dia.	5 Ft.	Metal	5.3
Ceramics Lab	6" Dia.	305 Ft.	Metal	59.8
	8" Dia.	20 Ft.	Metal	7.1
	8" Dia.	15 Ft.	Plastic	5.3
	12" Dia.	8 Ft.	Plastic	6.3
	14" Dia.	25 Ft.	Metal	26.7
	20" Dia.	45 Ft.	Metal	98.2
Process Development Lab	6" Dia.	80 Ft.	Metal	15.7
	8" Dia.	10 Ft.	Metal	3.5
	8" Dia.	15 Ft.	Plastic	5.3
	10" Dia.	12 Ft.	Metal	9.4
	12" Dia.	10 Ft.	Metal	7.9
	12" Dia.	35 Ft.	Plastic	27.5
	20" Dia.	5 Ft.	Metal	10.9
	20" Dia.	12 Ft.	Plastic	26.2
Chemical Processing	6" Dia.	195 Ft.	Metal	38.3
	8" Dia.	40 Ft.	Metal	14.1
	12" Dia.	40 Ft.	Metal	31.4
	14" Dia.	15 Ft.	Metal	16.0
	20" Dia.	20 Ft.	Metal	43.6
Analytical Lab	6" Dia.	50 Ft.	Plastic	9.8
	10" Dia.	37 Ft.	Plastic	20.0
	14" Dia.	12 Ft.	Plastic	12.8
	20" Dia.	45 Ft.	Plastic	98.2
	12" x 24"	45 Ft.	Plastic	90.0
Instrument Lab	6" Dia.	50 Ft.	Plastic	9.8
	14" Dia.	12 Ft.	Plastic	12.8
Penthouse	20" Dia.	50 Ft.	Plastic	109.1
	24" x 24"	60 Ft.	Plastic	240.0
	18" x 36"	15 Ft.	Plastic	67.5
	20" Dia.	45 Ft.	Metal	98.2
	16" Dia.	12 Ft.	Metal	16.8
	16" x 30"	35 Ft.	Metal	116.7
	12" x 36"	30 Ft.	Metal	90.0

CHEMICAL PROCESS TANKS AND COLUMNS

Identification	Size Diameter x Height	Volume Ft^3	Remarks
R-3	6" x 120"	2.0	SS Tanks in Box 242
R-4	6" x 144"	2.4	
R-11	6" x 108"	1.8	
R-7	24" x 90"	25.5	SS Tanks in Box 241
R-8	25" x 90"	25.5	
R-14	36" x 72"	42.4	
R-15	36" x 78"	45.9	
R-12	30" x 136"	55.6	SS Tank in Box 233A
R-9	6" x 30"	.5	Glass IX Columns in Box 231
R-10	6" x 30"	.5	
R-20	6" x 30"	.5	
S-1	4" x 36"	.3	Glass Columns in Box 202
S-2	4" x 36"	.3	
S-9	4" x 36"	.3	Glass Columns in Box 221
S-10	4" x 36"	.3	
E-16	6" x 24"	.4	SS Vacuum Traps in Box 232
E-17	6" x 24"	.4	
E-15	4" x 24"	.2	Glass Column in Box 301

CONTAMINATED EQUIPMENT

Identification	Size	Volume Ft^3	Remarks
Centerless Grinder	53" x 36" x 28"	31.0	Box 423
Emission Spectrometer	141" x 39" x 28"	89.1	Analytical Lab
Tube Furnace	38" x 21" x 24"	11.0	Box 212
Tube Furnace	38" x 21" x 24"	11.0	Box 222
Rototherm Evaporator		2.0	Box 201
Mortar Grinder	18" x 16" x 10"	1.7	Box 302
Belt Furnace	103" x 13" x 13"	10.0	Chem Process Lab
Sintering Furnace	67" x 10" x 7" 82" x 53" x 55" 49" x 32" x 23	3.0 139.0 21.0	Ceramics Lab - 3 Sections
Walking Beam Furnace	25" x 24" x 20" 65" x 20" x 53" 165" x 60" x 92" 39" x 37" x 61" 25" x 22" x 35"	9.8 40.0 527.0 51.0 11.0	North Lab - 5 Sections Uranium Contamination Only
Muffle Furnace	26" x 18" x 19"	5.1	Box 152
Mini-Mite Furnace	14" x 15" x 12"	1.5	Box 121
Mini-Mite Furnace	14" x 15" x 12"	1.5	Box 122
Furnace	16" x 14" x 12"	1.6	Box 101
Filter Housing	15" x 15" x 18"	2.3	Chem Process Lab
Conveyor Return		12.0	Box 414
B&L Microscope	16" x 24" x 14"	3.1	Box 604
Overhead Conveyor		8.0	Box 412
Overhead Conveyor		8.0	Box 417

CONTINUED

CONTAMINATED EQUIPMENT (CONTINUED)

Identification	Size	Volume Ft^3	Remarks
Caisson Filter M-2003	12" x 14" x 14"	1.4	Chem Process Lab
Fixture and Boats, Inconel		8.0	Belt Furnace
Mettler Balance P5N	18" x 10" x 14"	1.5	Box 412
Mettler Balance P1200N	14" x 8" x 10"	.7	Box 412
Mettler Balance P163	14" x 8" x 10"	.7	Box 417
Mettler Balance PS115	24" x 10" x 14"	2.0	Box 417
Pellet Press	18" x 42" x 18"	8.0	Box 401
Pellet Press	18" x 42" x 18"	8.0	Box 411
Pellet Press	18" x 42" x 18"	8.0	Box 418
Suspect Waste Tank	1,000 Gallons	133.7	R-41
Suspect Waste Tank	1,000 Gallons	133.7	R-42
Suspect Waste Tank	1,000 Gallons	133.7	R-43
Twin Shell Blender	30" x 30" x 24"	12.5	Box 402
Vacuum Oven	21" x 25" x 16"	5.0	Box 422
Vacuum Oven	21" x 25" x 16"	5.0	Box 422
Press Hydraulic Unit	33" x 24" x 38"	17.4	Ceramics
Press Hydraulic Unit	33" x 24" x 38"	17.4	Ceramics
Press Hydraulic Unit	33" x 24" x 38"	17.4	Ceramics
Mount Polisher	30" x 12" x 16"	3.3	Box 601
Mount Polisher	24" x 10" x 12"	1.7	Box 601
Mount Polisher	16" x 14" x 16"	2.1	Box 602
Mount Polisher	24" x 20" x 16"	4.4	Box 602

CONTINUED

CONTAMINATED EQUIPMENT (CONTINUED)

Identification	Size	Volume Ft3	Remarks
Vacuum Oven	16" x 14" x 12"	1.6	Box 424
Vacuum Oven	16" x 14" x 12"	1.6	Box 424
Vacuum Oven	16" x 14" x 12"	1.6	Box 424
Centrifuge	24" x 22" x 24"	7.3	Box 423
Moisture Analyzer	18" x 13" x 14"	1.9	Box 421
Mount Press	12" x 18" x 12"	1.5	Box 602
Granulator	16" x 28" x 12"	3.1	Box 401
Sieve Shaker	20" x 16" x 16"	3.0	Box 303
Sieve Shaker	20" x 16" x 16"	3.0	Box 303
Line Breaker	16" x 9" x 9"	1.0	Box 421
Line Breaker	16" x 9" x 9"	1.0	Box 422
Line Breaker	16" x 9" x 9"	1.0	Box 323
Mettler Balance P11	18" x 10" x 14"	1.5	Box 424
Mettler Balance P3	18" x 10" x 14"	1.5	Box 422
Mettler Balance P1200N	14" x 8" x 10"	.7	Box 422
Mettler Balance P120	14" x 8" x 10"	.7	Box 421
Mettler Balance P6	18" x 10" x 14"	1.5	Box 420
Mettler Balance P3N	18" x 10" x 14"	1.5	Box 305
Mettler Balance P2000N	14" x 8" x 10"	.7	Box 304
Mettler Balance P10	18" x 10" x 14"	1.5	Box 302
Mettler Balance P5N	18" x 10" x 14"	1.5	Box 302

CONTINUED

CONTAMINATED EQUIPMENT (CONTINUED)

Identification	Size	Volume Ft^3	Remarks
Mettler Balance H10T	18" x 9" x 17"	1.6	Box 134
Mettler Balance H10	18" x 9" x 17"	1.6	Box 121
Mettler Balance H10	18" x 9" x 17"	1.6	Box 102
Mettler Balance H20T	18" x 9" x 17"	1.6	Box 101
Leco Analyzer WR12	20" x 15" x 25"	4.4	Box 102
Mettler Balance H10T	18" x 9" x 17"	1.6	Box 122
Mettler Balance H10	18" x 9" x 17"	1.6	Box 152
Mettler Balance H20T	18" x 9" x 17"	1.6	Box 153
Moisture Analyzer	18" x 13" x 14"	1.9	Box 102
Vacuum Oven	16" x 14" x 12"	1.6	Box 101
Cable Trolley Conveyor		10.0	Box 425
Ohaus Beam Balance	30" x 12" x 14"	3.0	Box 402
Welding Chamber		1.0	Box 503
Rolling Mill	24" x 17" x 16"	3.8	Box 303
Arc-Spark	12" x 12" x 17"	1.5	Box 161
Ultra Sonic Cleaner	16" x 8" x 11"	1.0	Box 602
Roller Smith Balance	12" x 8" x 18"	1.0	Box 151
Crucible Furnace	15" x 15" x 17"	2.2	Box 222
Stainless Steel Tank	30" Dia. x 52" H	21.3	Box 201
Stainless Steel Tank	30" Dia. x 52" H	21.3	Box 201
Stainless Steel Tank	14" Dia. x 22" H	2.0	Box 201

APPENDIX B

PFDL OPERATING PROCEDURES, PFDL ADMINISTRATIVE PROCEDURES, PFDL ANALYTICAL LABORATORY PROCEDURES, AND CHESWICK SITE INDUSTRIAL HYGIENE PROCEDURES

This appendix is contained in microfiche form in the pocket on the inside back cover of this volume. For the benefit of the microfich user, the various sections of Appendix B are contained on the following pages of the microfiche.

WCAP-10574

WESTINGHOUSE CLASS 3

DECONTAMINATION AND DECOMMISSIONING OF THE WESTINGHOUSE NUCLEAR FUEL FACILITY AT CHESWICK, PA

FOR

UNITED STATES DEPARTMENT OF ENERGY

CONTRACT NO. DE-AC06-82RL10363

Volume 2 of 2

PA-10-3

J. V. Denero
R. A. Lange
M. L. Ray
J. L. Shoulders
H. C. Woodsum

June 1984

APPROVED: [signature]
J. V. Cupo, Manager
Engineering and Technology Service

Work Performed Under Shop Order Number PFDL-50503

WESTINGHOUSE ELECTRIC CORPORATION
NUCLEAR ENERGY SYSTEMS
P.O. BOX 3912
PITTSBURGH, PA 15230

7471B:1b/061384

DISCLAIMER

TABLE OF CONTENTS

APPENDIX C

REQUESTS FOR APPROVAL AND DRAWINGS FOR GALVANIZED DRUMS, EPOXY-COATED CORRUGATED STEEL BOXES, FIBERGLASS-REINFORCED POLYESTER-COATED PLYWOOD BOXES, AND NON-TRU WASTE CONTAINERS

GALVANIZED DRUMS

Request for Package Approval No. 1, Rev. 3
Request for Package Approval No. 9, Rev. 1
Rockwell Hanford Operations Specification HS-BP-0008

EPOXY COATED CORRUGATED STEEL BOXES

Request for Package Approval No. 7, Rev. 0
Rockwell Hanford Operations Drawing H-2-91888
Rockwell Hanford Operations Drawing H-2-91888 As Modified
General Electric Drawing 272E81-28

FIBERGLASS-REINFORCED POLYESTER-COATED PLYWOOD BOXES

Request for Package Approval No. 8, Rev. 0
Westinghouse Drawing 1620E43, Sub 3 G025
Westinghouse Specification E-955 048

NON-TRU WASTE CONTAINERS

Request for Package Approval No. 5, Rev. 0
Request for Package Approval No. 6, Rev. 0
Argonne National Laboratory Drawing LS-2273
Westinghouse Drawing 2044F14
Mound Laboratory Drawing AYD 750375

REQUEST FOR PACKAGE APPROVAL NO. 1, REV. 3

A. DRAWINGS OR BLUEPRINTS OF THE SYSTEM

Does not apply since these are DOT specification containers. Attached are sketches showing the package systems to be used by Westinghouse. These systems are:

Figure 1: Packaging of Transuranic Waste in a 55-Gallon Steel Drum

Figure 2: Packaging of Solidified Liquid Transuranic Waste in a 55-Gallon Steel Drum.

B. TYPE OF SOLID WASTE CONTAINER

Steel drum, 55-gallon capacity.

C. SIZE OF SOLID WASTE CONTAINER

Approximately 24" diameter by approximately 35" high.

D. RIGGING AND HANDLING APPURTENANCES

None. Standard 55-gallon drums. Individual handling will be required with one drum per Model N-55 overpack or eight drums per Model 6272 overpack.

NOTE: The drums in the Model 6272 overpack will have to be removed from an M-III bin described in the Westinghouse Request for Package Approval No. 2. The bins are to be returned to Westinghouse.

E. DOT SPECIFICATION NUMBER, NRC CERTIFICATION OF COMPLIANCE NUMBER, OR DOE CERTIFICATE OF COMPLIANCE NUMBER OF THE SHIPMENT

1. Waste Container

   a. Galvanized DOT 17C (49 CFR 178.115) 55-gallon steel drums purchased to the requirements of HWS 10242.

   b. DOT Specification 17H (49 CFR 178.118) and DOT Specification 17C (49 CFR 178.115) 55-gallon steel drum (Section R).

2. Transportation Overpack

USNRC Certification of Compliance No. 9070 (N-55 overpack) or USNRC Certification of Compliance No. 6272 (Poly Panther overpack).

F. LIMITATION OF THE CONTAINER

As described.

G. TYPES AND KINDS OF WASTE TO BE SHIPPED

1. Soft, Combustible Transuranic Waste

Plastic bags, rubber gloves, paper, etc. will be placed within two heat-sealed 12-mil thick PVC bags. These packages will be placed in a drum lined with a heat-sealed 12-mil thick PVC drum liner. Figure 1 shows a sketch of this package system.

2. Hard, Noncombustible Transuranic Waste

Tools, equipment, etc. will be placed within two heat-sealed 12-mil thick PVC bags. Sharp-edged and pointed items will be rounded off or blunted prior to packaging. These bags will be placed in a drum lined with a heat-sealed 12-mil thick PVC drum liner. Figure 1 shows a sketch of this package system.

3. Hard, Combustible Transuranic Waste

Absorbed oils in plastic bottles will be placed within two heat-sealed 12-mil thick PVC bags. These bags will be placed in a drum lined with a heat-sealed 12-mil thick PVC drum liner and surrounded by absorbent material. Figure 1 shows a sketch of this package system.

4. Solidified Liquid Transuranic Waste

a. Liquid wastes will be mixed with concrete and poured into a 30-gallon drum centered in a 55-gallon drum held in place by absorbent material and sealed within a 12-mil thick PVC drum liner. Figure 2 shows a sketch of this package system.

b. Liquid wastes will be mixed with concrete and poured into gallon bottles which will be placed within two heat-sealed 12-mil thick PVC bags. These bags will be placed in a drum lined with a heat-sealed 12-mil thick PVC drum liner and surrounded by absorbent material. Figure 1 shows a sketch of the package system.

H. HEAT OUTPUT OF THE PACKAGE IF GREATER THAN 0.1 W/FT^3

The heat output of the package will not exceed 0.1 w/ft^3.

I. TYPES AND ESTIMATED QUANTITIES OF RADIOACTIVE MATERIALS, INCLUDING DOSE RATE

A maximum of sixty grams of plutonium and uranium-235 may be found in each drum described above. The dose rates will not exceed 200 mrem/hr as measured at the surface. In addition, the contents will be limited to a Type B quantity of radioactivity (10 CFR 71.4g).

J. TYPES AND QUANTITIES OF TOXIC MATERIALS (OTHER THAN RADIOACTIVE COMPONENTS) AS DEFINED IN "DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS"

None of these materials will be present.

K. WEIGHT OF SYSTEM TO BE BURIED

The maximum weight of any single drum will be 550 pounds (250 kg) for the Model N-55 overpack and 840 pounds (382 kg) for the Model 6272 overpack. Actual weights will be found on the drums.

L. RATE OF INTERNAL OR RADIOLYTIC GAS GENERATION DURING STORAGE

The gas generation rate is acceptable per calculations made for Revision 0 of this Approval Request.

M. QUANTITY OF FISSILE MATERIAL TO BE SHIPPED

A maximum of sixty grams of fissile material in each drum will be shipped in the form of plutonium and uranium-235 (Section I).

N. IF TRU WASTE, DOES THE CONTAINER MEET THE 20-YEAR RETRIEVABILITY REQUIREMENTS?

Yes, if the DOT 17H and DOT 17C painted drums (Section R) have no scratches or rust. (An undercoat and a final finish will be used to correct these defects.)

O. TURNAROUND TIME REQUIRED TO RELEASE TRANSPORT EQUIPMENT

The transport equipment should be unloaded and released within a 24-hour period after its arrival.

P. NUMBER OF CONTAINMENT SYSTEMS

The total number of 55-gallon drums is currently estimated to be 1,500.

Q. NAME, ADDRESS, AND TELEPHONE NUMBER OF THE SHIPPER

Westinghouse Electric Corporation, Nuclear Fuel Division, Cheswick Avenue, Cheswick, PA 15024, Area Code 412 963-5517 Jack Shoulders for technical requirements and Area Code 412 963-5518 David Petrarca for shipping/scheduling.

R. MISCELLANEOUS

A waiver is required for filled DOT 17H and DOT 17C 55-gallon drums packaged prior to receipt of DOT 17C galvanized drums.

S. REVISION

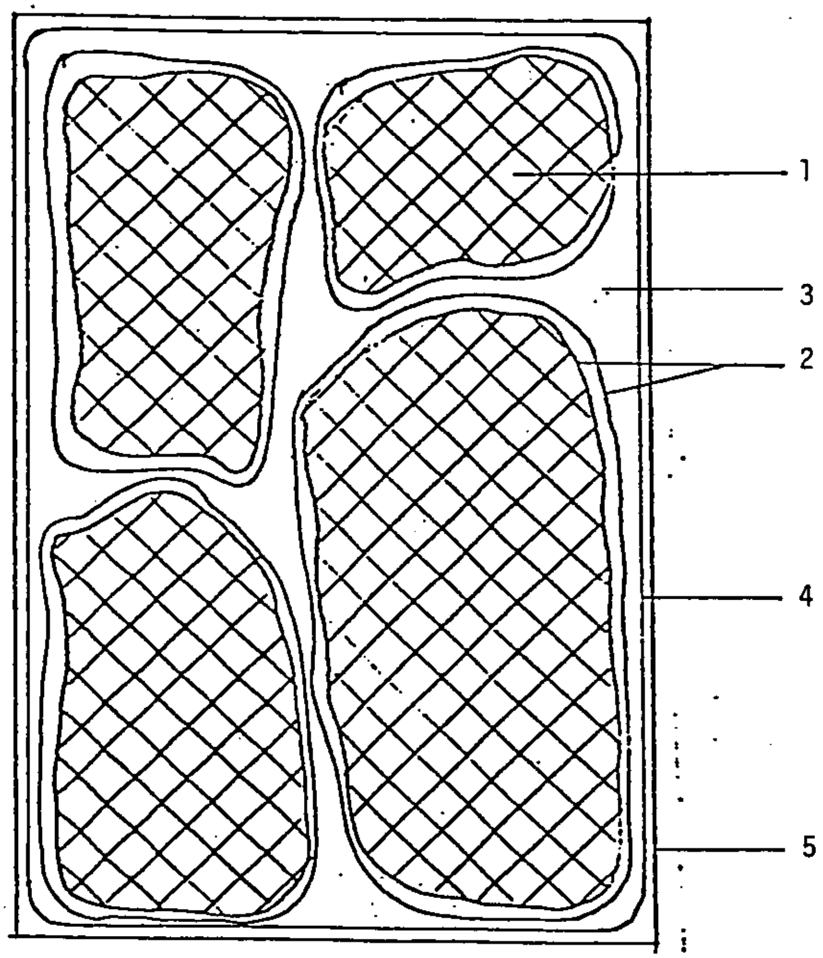
1. a. Added use of Model 6272 overpack to transport drums.

   b. Added hard, combustible waste category for absorbed oils.

2. Reduced usage of polyurethane foam for drums shipped in Model 6272 overpack.

3. Deleted Model 6400 (Super Tiger) overpack requirements. Added Model N-55 overpack requirements. Added cement in bottles. Increased quantity.

FIGURE 1. PACKAGING OF TRANSURANIC WASTE IN A 55-GALLON STEEL DRUM



1. Waste - Noncombustible materials, such as tools, equipment, etc., or gallon bottles of liquids solidified in concrete; or combustible materials, such as plastics, gloves, Kimwipes, etc., or plastic bottles of absorbed oils.

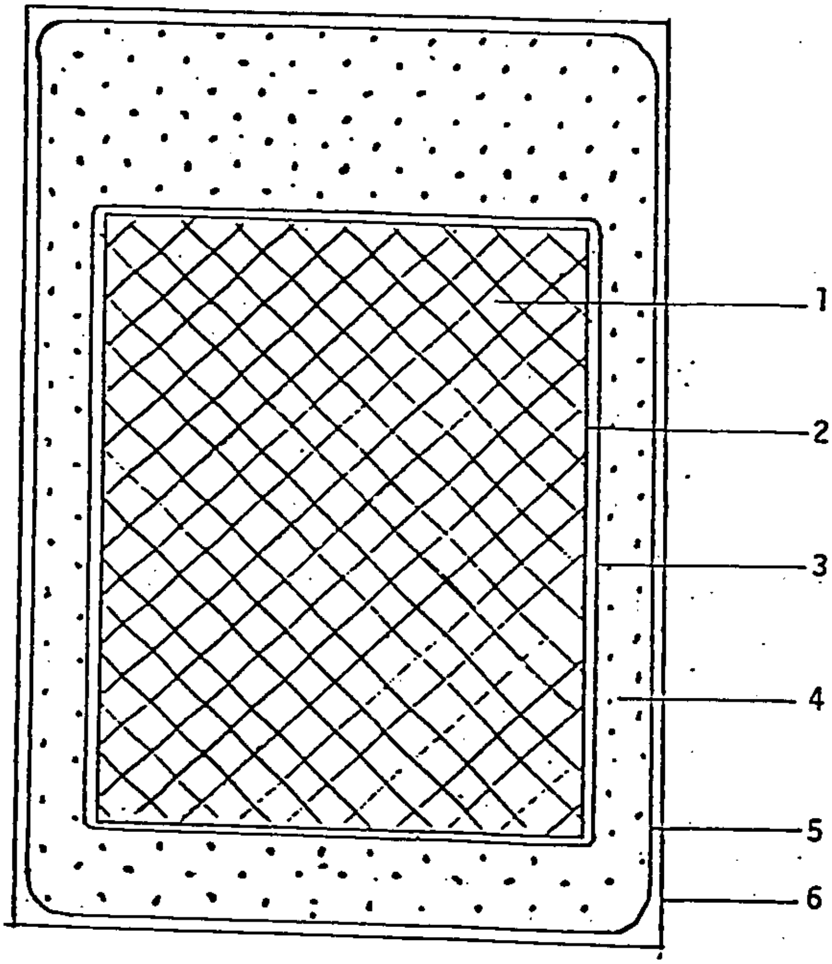
2. Two heat-sealed 12-mil thick PVC bags.

3. Polyurethane foam bracing (as required) for noncombustible equipment items, or absorbant to surround bottles of concrete or absorbed oils.

4. Heat-sealed 12-mil thick PVC drum liner.

5. 55-Gallon drum.

FIGURE 2. PACKAGING OF SOLIDIFIED LIQUID TRANSURANIC WASTE IN A 55-GALLON STEEL DRUM



1. Waste - Liquid, solidified in concrete.
2. Thirty-gallon drum (plastic fiber pack).
3. Sealed plastic liner (heat-sealed 12-mil thick PVC).
4. Absorbant.
5. Sealed plastic liner (heat-sealed 12-mil thick PVC).
6. 55-Gallon drum.

REQUEST FOR PACKAGE APPROVAL NUMBER 9, REVISION 1

Galvanized DOT 17C 55-gallon steel drums will be packaged as described in Request for Package Approval Number 1, Revision 3, except that they will contain mercury compounds packaged as follows:

> Mercury will be mixed with Fisher Scientific's "Mercury Absorbant Powder" (Catalog #09-77T-14) to form an amalgam which will be double bagged and surrounded by a minimum of 6" of concrete in a galvanized, 55-gallon drum. The drum will contain no other waste.
>
> Containers with the absorbed mercury will be labeled as a poison in addition to radioactive labels.

SPECIFICATION RELEASE RECORD

Contractor Name	Facility Or Project Identification	SRR No.
ROCKWELL HANFORD OPERATIONS	WASTE PACKAGING	10003

Specification No.	Rev	TITLE
?S-BP-0008	BASIC	DRUM, DOT 17C, 55 GALLONS, GALVANIZED

Originator: J. D. Anderson *J D Anderson*

Dept.	Phone	DATE
TF & EPC	3-4312	8-25-82

Design *G. T. Dukelow*	*8/25/82*
Check	
Quality Assurance	
Project	
Program	

Key Words
TRU STORAGE, SHIPPING, DRUM, 55 GALLONS, GALVANIZED.

C-9

DISTRIBUTION

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NAME	LOC.	QTY.
J. D. Anderson	2750-E D127	1
H. E. Manning	2101-M/MO-047	1
J. A. Manker	1166 Bldg	1

INFORMATION ONLY

NAME	LOC.	QTY.
J. F. ALbaugh	2750-E/A-137	1
F. J. Barron	1166 Bldg	1
G. A. Beitel	2750-E/A-224	1
G. T. Dukelow	2750-E/A-107	1
J. J. Hogan	2750-E/C-1-BAY	1
H. H. Kohl	2750-E/D-199	1
R. W. Szempruch	200W/222-U	1
J. L. Watkins	2101-M/MO-047	1

Release Stamp
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A-6400-119 (N-7-80)

Prepared By		Number
H. E. Manning H. E. Manning	Rockwell Hanford Operations P. O. Box 800 Richland, Washington 99352	HS-BP-0008
Department: Design Engineering		Type: Procurement
		Date: 8-25-82
Classified ☐ Unclassified ☒	CAUTION THIS DOCUMENT NOT COMPLETE WITHOUT THESE ATTACHMENTS SPECIFICATION	Supersedes Spec HWS 10242 Rev 4 Dated 2-01-81
		Rev Ltr: BASIC — Page 1 of 7 Total Pages

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Title

Drum, DOT 17C, 55 Gallons, Galvanized

Approvals

J. L. Watkins — Design Engineering

9/1/82 H.S.&E.

D. G. Dubelier — T.F.&E.P.C.

R. E. May — Q.A.

List Of Revisions

The following changes were made in revising HWS 10242 (same title) into this HS-BP-0008.

Section - all — Removed terms and references that are not needed by the drum manufacturer or the galvanizer to do their job.

Section 3 — Required same zinc thickness on lids (both sides) as for the inside and outside of the drums.

Removed phrases that repeated what is contained in the ASTM standards which had already been stated as a requirement.

Removed notes that told the galvanizer HOW to do his work.

Limited the passivation process to chromate only.

Eliminated tubular gaskets as an option.

Section 4 — Simplified the Receiving Inspection requirements.

Section 5 — Removed detailed packaging specifications and placed the performance requirements on the Seller. Moved the specifications to NOTES for the Seller's guidance only.

Section 6 — NOTES

6.3 — Provided guidance in design and packaging to the Seller.

Seciton 7 — Added requirements for data to be submitted with the bid.

Void After: 8-25-84	Mandatory Review Date: 8-25-83	Releasing SRR No.: 10003

A-6400-117 (R-12-80)

DRUM, DOT 17C, 55 GALLONS, GALVANIZED

1.0 SCOPE

1.1 Scope. This specification provides the requirements for new, full removable head, DOT-17C hot dip galvanized 55 gallon drums.

2.0 APPLICABLE DOCUMENTS

2.1 Applicability. The following documents, of the issue shown, form a part of this specification, to the extent specified herein. In the event of a conflict between the documents referenced and the contents of this specification, this specification shall take precedence.

U.S. Department of Transportation (DOT)

Title 49 Code of Federal Regulations, Part 178.115 Specification 17C, Steel Drums, dated October 1, 1981.

Federal Specifications

PPP-F-320D	Fiberboard, Corrugated and Solid, Sheet Stock

American Society for Testing and Materials

ASTM D 1418-79a	Rubber and Rubber Latices - Nomenclature
ASTM A 153-80	Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM B 633-78	Electrodeposited Coatings of Zinc on Iron and Steel

3.0 REQUIREMENTS

3.1 Drums

Drums supplied under this specification shall meet all the requirements of DOT 17C, 55 gallon, single trip, full removable head containers with the following exceptions and addition:

Exceptions: The following sections of DOT 17C shall not apply
Section: 178.115-8 (b) and
178.115-8 (c) entirely

Addition: The full removable head, the permanent head and the sides of the drum shall each be made from a single sheet of metal without openings of any kind, plugged or otherwise closed.

3.2 Dimensions of the Drum shall be:

Overall height, cover on	34 13/16 inches ± 1/8 inch
Height, cover off	34 3/8 inches ∓ 1/8 inch
Inside diameter	22 1/2 inches ± 1/8 inch

Black bar in the margin indicates change from the previous issue of the specification.

3.3 Drums and Lids shall be coated inside and out with zinc, to meet the requirements of ASTM A 153, Class B-2, after all welding has been completed.

Sharp projections of zinc, such as tears or spikes, on the inside and outside of the drum or lid, will be a safety hazard to the Buyer's personnel and shall be prevented. (See ASTM A 153, paragraph 5 Note 4).

Lids may be made from mill galvanized sheet steel, providing the finished product meets the same requirements for sheet material, thickness and zinc coating weight as the assembled and hot-dipped zinc coated drum.

ASTM A 153, Weight of Coating Test requiring stripping, and Packaging Requirements shall not apply.

The zinc coating on the inside and outside of the drums and lids shall be treated with a chromate passivation process. The treatment shall leave a visible coloration that is distinguishable from a plain galvanized surface.

3.4 Closure Rings, Nuts and Bolts

3.4.1 Dimensions shall meet the applicable requirements of DOT 17C. When assembled on the closed drum, the ring shall have 3/16 inch gap, minimum, with the bolt torqued to 40 foot pounds. The bolt shall be long enough that a minimum of three full threads shall be engaged with the lug when the ring is relaxed and the lid is in place.

Two holes 3/16 inch in diameter, shall be drilled through the bolt, one through the head and one, 1-1/4 inches from the end of the threaded portion, as shown in Figure 1.

3.4.2 Zinc Coating shall be applied to all surfaces of rings, nuts and bolts after all welding has been completed.

The coating shall be either:

(a) Hot-dipped galvanized per ASTM A 153, Class C or,

(b) Electroplated zinc per ASTM B 633, Type I, thickness classification number Fe/Zn 5.

Dimensions of all components shall be adjusted before coating or after to accommodate the added thickness of the zinc. Zinc coated threaded parts shall be coated with a lubricant which shall be dry to the touch. Coated parts shall be easily assembled.

ASTM A 153, Weight of Coating Test, requiring stripping, and the Packaging requirements shall not apply.

3.5 Gaskets A gasket shall be attached by the Seller to each lid and be adequate to prevent leakage as required by DOT 17C, Part 178.115-8.

Gaskets may be one of the following:

3.5.1 Styrene-butadiene rubber (SBR) as classified in ASTM D 1418. SBR gaskets may be provided in either of two forms.

3.5.1.1 Foam gaskets, foamed in-place to form a gasket in the recess in the drum lid. When the gaskets are formed, the component-mix materials used to make the foam shall be within age limits set by their manufacturer. The cured foam shall have a density of not less than 40 pounds per cubic foot.

3.5.1.2 Preformed foam gasket, reactangular in cross-section, adhesively bonded in the recess of the lid. The foam shall have a density of not less than 40 pounds per cubic foot and a shelf life of not less than 2 years remaining at the time it is installed in the lid.

3.5.2 Alternate type of gasket. The Seller may submit a proposal for the Buyer's approval, to substitute any other gasket material with a minimum expected useful life of 20 years.

3.6 Marking. In addition to the marking required by specification DOT 17C, a lot identification shall be embossed with characters a minimum of 3/4 inches high and a minimum of 1/32 inches deep either on the body below the center of the drum or on the permanent head of the drum. Each shipment shall constitute one lot. The first lot delivered against a purchase order shall be marked "A", the second "B", etc. Following "Z", two characters shall be used, such as "AA", "BB", etc. The letters I, O, Q and X shall not be used. All markings shall remain legible after galvanizing.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Quality Program. The Seller shall maintain and document a quality program that complies with contract requirements. The Seller's quality system shall be subject to review and approval at all times by the Buyer. Should the Seller be a distributor furnishing material not of his own manufacture, the Manufacturer whose product is furnished shall be qualified by the Seller as stated above. The Seller shall identify the Manufacturer and supply this information to the Buyer with each shipment.

4.2 Testing. It shall be the responsibility of the Seller to carry out the required tests and controls to insure that the drums meet the requirements of this specification and meet the required testing of 49 CFR, 178.115. The Buyer reserves the right to inspect the drums for conformance to requirements when deemed necessary to assure that the drums conform to these specifications.

4.3 *Receiving Inspection Requirements. Acceptance or rejection of the drums* at the Buyer's plant shall be based on the following:

4.3.1 Sampling Plan. From each lot (shipment) received, a set of 10% of the drums *will be picked at random for receiving inspection. If any of these* drums fail to pass inspection, the drums that failed shall be rejected and another set of drums shall be randomly selected from the same lot and inspected. If any drums from this set fail inspection, the entire lot shall be rejected.

4.3.2 Drums and Lids shall be inspected for compliance with the following items.

4.3.2.1 Preparation for Delivery requirements, Section 5.0, this specification.

4.3.2.2 Correct markings, (DOT 17C) and paragraph 3.6, this specification.

4.3.2.3 Workmanship, Finish and Appearance (per ASTM A 153, paragraphs 5.1 and 5.2) and paragraphs 3.3 and 3.4.2 of this specification.

4.3.2.4 Gaskets shall be inspected for compliance with the requirements of paragraph 3.5 of this specification.

4.3.3 Closure Rings, Nuts and Bolts shall be inspected for compliance with paragraph 3.4, this specification, and ASTM A 153, paragraphs 5.1 and 5.2 for hot-dipped zinc or ASTM B 633, paragraph 7.5 Workmanship for Electro-deposited zinc.

4.3.4 Unacceptable drums will be subject to rejection to the Seller.

5.0 PREPARATION FOR DELIVERY

5.1 The Seller shall be responsible for the drums, lids, rings, nuts and bolts to arrive at the Buyers facilities in a condition to meet the requirements cited in Section 3 REQUIREMENTS. Recommended protective packaging is discussed in Section 6 NOTES.

5.2 Closure rings, nuts and bolts shall be packaged separately from the drums.

6.0 NOTES

This Section contains non-mandatory, non-contractual information which is intended as guidance only. Nothing stated in this Section shall be used as authorization to spend money, do work, accept or reject a product.

6.1 Intended Use of these drums is for long-term corrosion resistant outdoor and underground storage containers.

6.2 Additional Inspection instruction for Rockwell inspectors is contained in Supporting Document SD-WM-NDE-000, "Inspecting Zinc Coated Products".

6.3 Design Considerations.

Sizing of the closure ring should be considered because the drum and ring dimensions will change with the addition of the zinc coatings.

The curl (top of the drum) should be spaced away from the body of the drum sufficiently wide to allow for ease of entry and drainage of melted zinc, flux, and chromate solutions. This should avoid entrapment of materials that could drain out later on the drum sides and make the finish rejectable.

6.4 Galvanizing Operations. Care should be taken to assure that zinc coated articles shipped to the Buyer are free from uncoated areas, blisters, flux deposits, black spots, dross inclusions and other types of projections that would interfere with their use.

6.5 Protection in Shipping. The Buyer cannot accept drums which would require touch-up or repair. Following is an outline of packaging and shipping methods which have been successful in protecting drums in transport to the Buyer in the past.

6.5.1 Drums should be throughly dried before packaging for shipping.

6.5.2 Care should be taken in handling and shipping to prevent scratches, dents or other damage which could adversely affect the intended use of the drums (6.1).

6.5.3 The exterior surfaces of the drums may be protected by wrapping the body of each drum with 42-26A flute single face corrugated fiberboard. Each layer of stacked drums should rest on a layer of 42-26A flute 200 pound corrugated fiberboard, including underneath the bottom layer of drums. All fiberboard described herein meets the requirements of PPP-F-320. Used material may be used if it provides the same degree of protection as new.

7.0 DATA SUBMITTAL REQUIREMENTS

7.1 With the Bid the Seller shall provide the following data for the product he proposes to supply from the requirements and options in this specification.

7.1.1 Procurement description for mill-galvanized sheet steel, if it will be used for lids (paragraph 3.3).

7.1.2 Description of active ingredients in the chromate passivation solution (paragraph 3.3).

7.1.3 Type(s) of zinc coating process to be used (paragraph 3.4.2).

7.1.4 Gasket material type the Seller will supply (paragraph 3.5) and its cost as a part of the total cost of a complete drum.

7.1.5 Type of lubricant to be applied to threaded components (paragraph 3.4.2).

7.1.6 Plan for protective packaging and shipping of drums and lids to meet the requirements of paragraph 5.1.

7.2 With each shipment the Seller shall provide written certification and test results showing compliance with the requirements of 49 CFR 178.115.

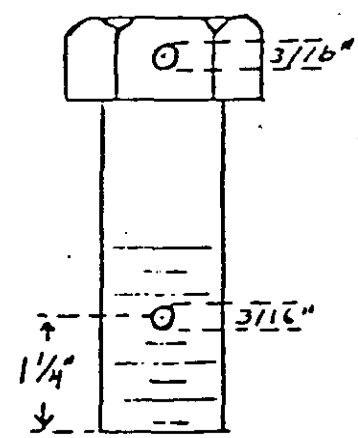


FIGURE 1. Bolt with Holes for Tamper Indicating Seals.

REQUEST FOR PACKAGE APPROVAL #7, REVISION 0

A. DRAWINGS OR BLUEPRINTS OF THE SYSTEM

Rockwell Hanford Operations' Drawing #H-2-91888, 7'0" x 6'0" x 6'0" Steel Corrugated Box Assembly, modified for compatibility with existing Model 6400 overpacks, attached.

B. TYPE OF SOLID WASTE CONTAINER

Steel box.

C. SIZE OF SOLID WASTE CONTAINER

Approximately 84" x 70" x 66".

D. RIGGING AND HANDLING APPURTENANCES

Lifting straps and skids per drawing (Section A). Two boxes per overpack, one overpack per truck.

E. DOT SPECIFICATION NUMBER, NRC CERTIFICATE OF COMPLIANCE NUMBER, OR DOE CERTIFICATE OF COMPLIANCE NUMBER OF THE SHIPMENT

A Model 6400 overpack will be used per NRC's approval of Westinghouse's request for exemption, attached.

F. LIMITATION OF THE CONTAINER

Container's limitations will be as described.

G. TYPES AND KINDS OF WASTE TO BE SHIPPED

The waste to be shipped will be as described in 4.b, 4.c, 4.d, and 4.e of the NRC's approval letter (Section E).

H. HEAT OUTPUT OF THE PACKAGE IF GREATER THAN 0.1 w/ft^3

The heat output of the package will not exceed 0.1 w/ft^3.

I. TYPES AND ESTIMATED QUANTITIES OF RADIOACTIVE MATERIALS INCLUDING DOSE RATE

The maximum quantity of material (plutonium and uranium) in each box shall not exceed quantities specified by the NRC's approval letter (Section E). The dose rates will not exceed 200 mrem/hr as measured at the surface.

J. TYPES AND QUANTITIES OF TOXIC MATERIALS (OTHER THAN RADIOACTIVE COMPONENTS) AS DEFINED IN "DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS"

None of these materials will be present.

K. WEIGHT OF SYSTEM TO BE BURIED

The weight of each empty box is estimated to be 2,700 lbs. The maximum weight of any loaded box will be 12,000 lbs. (5,455 kg). Actual weights will be found on the box.

L. RATE OF INTERNAL OR RADIOLYTIC GAS GENERATION DURING STORAGE

Gas generation will be comparable with that for packages described in previous Westinghouse's approval requests.

M. QUANTITY OF FISSILE MATERIAL TO BE SHIPPED

The fissile material shipped in each bin will be in the form of plutonium and uranium-235 and will not exceed quantities specified by the NRC's approval letter (Section E).

N. IF TRU WASTE, DOES THE CONTAINER MEET THE 20-YEAR RETRIEVABILITY REQUIREMENTS?

Yes.

O. TURNAROUND TIME REQUIRED TO RELEASE TRANSPORT EQUIPMENT

The transport equipment should be unloaded and released within a 24-hour period after its arrival.

P. NUMBER OF CONTAINMENT SYSTEMS

The total number of boxes is currently estimated to be 12.

Q. NAME, ADDRESS, AND TELEPHONE NUMBER OF THE SHIPPER

Westinghouse Electric Corporation, Cheswick Avenue, Cheswick, PA 15024.
Area Code 412 274-6300
Technical Requirements: Jack Shoulders, Extension 554 or 655
Shipping/Scheduling: Dave Petrarca, Extension 288 or 655.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

APR 2 1 1981

APR 24

SAFEGUARDS & SAFETY

FCTC:RHO
71-6400

Westinghouse Electric Corporation
ATTN: Mr. A. J. Nardi
P. O. Box 355
Pittsburgh, PA 15230

Gentlemen:

Pursuant to 10 CFR Part 71, you are authorized to deliver to a carrier for transport waste which has been packaged in accordance with statements and representations made in your letters dated November 20 and December 15, 1980 and Janaury 12 and 20, and April 10, 1981 subject to the conditions stated below:

1. Model No.: 6400

2. Package Identification No.: USA/6400/B( )F

3. Drawings: Packaging is constructed in accordance with Protective Packaging, Inc., Drawing Nos.: 32106-1, Sheet 1, Rev. F; and 32106, Sheet 2; and either (1) Westinghouse Electric Corporation Drawing No. 2020D08, Sheet 1 and 2, Rev. 0; or (2) Babcock and Wilcox Company Drawing No. 11-D-2130, Rev. 0, as modified by Westinghouse Electric Corporation letter dated January 12, 1981; or (3) Nuclear Packaging, Inc. Drawing No. EG-60-01D, Sheets 1 and 2, Rev. 0, as modified by Westinghouse Electric Corporation letter dated January 20, 1981.

4. Contents:

   a. Large decontaminated equipment waste of such size as not to fit into a 55-gallon drum (with legs or other readily removable appendages removed). Not to exceed 5 grams plutonium within the package.

      Equipment waste surfaces must be decontaminated to a smearable level of no more than 150,000 dpm/100 cm^2 prior to fixation or until successive decontamination cleaning operations do not reduce the smearable contamination levels by more than ten percent. After fixation, equipment waste surfaces must have a smearable level of contamination of no greater than 10,000 dpm/100 cm^2. Outer surfaces must have a smearable level of contamination of no greater than 20 dpm/100 cm^2. Prior to fixing of contamination, large equipment waste must be inspected to insure that: (a) all sharp or protruding objects have been removed or blunted, and (b) pipe caps, gasketed blind flanges, covers, etc., have been installed wherever possible. Following such inspection, the inner surfaces must be fixed with "strip" or "clear" coating. The inner surface(s) may alternatively be fixed with a polurethane foam.

The large equipment waste must be enclosed in a tight fitting box constructed of 1-inch thick plywood. The space between the equipment and the box must be filled with foam and between equipment (1/2" minimum foam thickness).

b. Decontaminated hard waste items, such as equipment, metal cans, tools, etc., shall be double bagged within 12-mil thick PVC, with each bag heat sealed. The total fissile quantity of all the sealed packages in one container must not exceed 200 grams.

Hard waste surfaces must be decontaminated to a smearable level of no more than 150,000 dpm/100 cm^2 prior to fixation or until successive decontamination cleaning operations do not reduce the smearable contamination levels by more than 10 percent. After fixation, hard waste surfaces must have a smearable level of contamination of no greater than 10,000 dpm/100 cm^2. Prior to fixing of contamination, hard waste must be inspected to insure that sharp or protruding objects have been removed or blunted. Following such inspection, the outer surfaces must be fixed with "strip" or "clear" coating. Hard waste items such as furnace shells, muffles, or other items with large cavities not accessible for decontamination must be foaming within the cavities. Surfaces that are not easily accessible, e.g., interiors of small diameter tubing and piping which were in contact with process operations, must be swabbed or immersed in cleaning solution to insure removal of residual material. Open ends of the tubing and piping must be sealed using mechanical fittings.

Two drums containing hard waste items designated as Westinghouse I.D. No. ARD-80-014 and ARD-80-016 which were packaged before March 23, 1981, may be packaged in the following manner:

Wiping and brushing of the components had been completed to remove all residual contamination. The components were individually double bagged within 12-mil thick PVC bagging material. Each bag was heat sealed and assayed. The items were foamed rigidly in place within a DOT Specification 17H 55-gallon steel drum, equipped with a standard drum closure, such that a minimum annular thickness of 2 inches was maintained between the waste packages and inner drum wall. A minimum thickness of 3 inches of foam (foamed in place) was maintained between the bottom of the drum and the lowermost waste package, and between the lid of the drum and the uppermost waste package. The foam has a nominal density of 0.029 g/cc.

The assay values for these drums are as follows:

ARD-80-014 = 45 grams ARD-80-016 = 53 grams

Sealed packages of hard waste must be enclosed in a tight-fitting, 1-inch thick plywood box constructed in accordance with Westinghouse Electric Corporation's Drawing No. 1620E43, Sheets 1, 2, 3, and 4, Rev. 3; or a tight-fitting 3/16" thick corrugated steel box constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91888, Sheet 1, Rev. 0. The space between the packages and the box must be filled with foam to a minimum thickness of 1 inch. Void spaces between the sealed packages must be filled with foam (1/2" minimum foam thickness).

c. Glove box absolute filters with sealed inlet and outlet areas must be double bagged within 12-mil thick PVC, with each bag heat sealed and packaged within DOT Specification 17H or 17C steel drums (maximum size of 55 gallons). Each drum must be lined with a sealed plastic liner and equipped with a standard drum closure. Each drum must not exceed a fissile quantity of 60 grams.

   Sealed drums must be enclosed in a tight-fitting 1-inch thick plywood box constructed in accordance with Westinghouse Electric Corporation's Drawing No. 1620E43, Sheets 1, 2, 3, and 4, Rev. 3; or a tight-fitting 3/16" thick corrugated steel box constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91888, Sheet 1, Rev. 0. The space between the drums and the box must be filled with foam to a minimum thickness of 1 inch. Void spaces between drums must be filled with foam (1/2" minimum foam thickness).

d. Soft waste items, such as sheeting, gloves, paper, prefilter media, polyethylene bottles, shoe covers, etc., must be double bagged in 12-mil thick PVC, with each bag heat sealed (bag size must not exceed 22" x 16" x 10") and packaged within DOT Specification 17H or 17C steel drums (maximum size of 55 gallons). Each drum must be lined with a sealed plastic liner and equipped with a standard drum closure. Each drum must not exceed a fissile quantity of 60 grams.

   Sealed drums must be enclosed in a tight-fitting 1-inch thick plywood box constructed in accordance with Westinghouse Electric Corporation's Drawing No. 1620E43, Sheets 1, 2, 3, and 4, Rev. 3; or a tight-fitting 3/16" thick corrugated steel box constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91888, Sheet 1, Rev. 0. The space between the drums and the box must be filled with foam to a minimum thickness of 1 inch. Void spaces between drums must be filled with foam (1/2" minimum foam thickness).

e. Liquid waste must be solidified in concrete in a 30-gallon drum which must be sealed in a plastic bag and centered and supported in a DOT Specification 17H or 17C 55-gallon steel drum by absorbent material. The 55-gallon drum must be lined with a sealed plastic liner and equipped with a standard drum closure. Each drum must not exceed a fissile quantity of 60 grams.

   Sealed drums must be enclosed in a tight-fitting 1-inch thick plywood box constructed in accordance with Westinghouse Electric Corporation's Drawing No. 1620E43, Sheets 1, 2, 3, and 4, Rev. 3; or a tight-fitting 3/16" thick corrugated steel box constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91888, Sheet 1, Rev. 0. The space between the drums and the box must be filled with foam to a minimum thickness of 1 inch. Void spaces between drums must be filled with foam (1/2" minimum foam thickness).

5. The maximum weight of the contents including secondary packaging, dunnage, shoring and bracing must not exceed 30,000 pounds.

6. Sufficient dunnage, shoring and/or bracing must be utilized to minimize secondary impact of the secondary packaging within the cavity under normal and accident conditions.

7. Protrusions from secondary packaging such as lifting eyes, etc., must be positioned such that they will not contact the cavity walls, or shoring must be provided to prevent puncture of the cavity walls by the protrusions under the normal and accident conditions.

8. Contents must be positioned in the cavity such that the center of gravity of the loaded package is substantially the same as the center of gravity of an empty package.

9. Package Model No. 6400 is exempt from the requirements of 10 CFR §71.42 only for the purpose of making these shipments.

10. This approval supersedes in its entirety approval (MacDonald to Sabo) letter dated January 26, 1981.

11. Expiration Date: December 31, 1981.

REFERENCES

Westinghouse Electric Corporation application dated July 13, 1973.

Supplements Dated: January 12 and 20, and April 10, 1981.

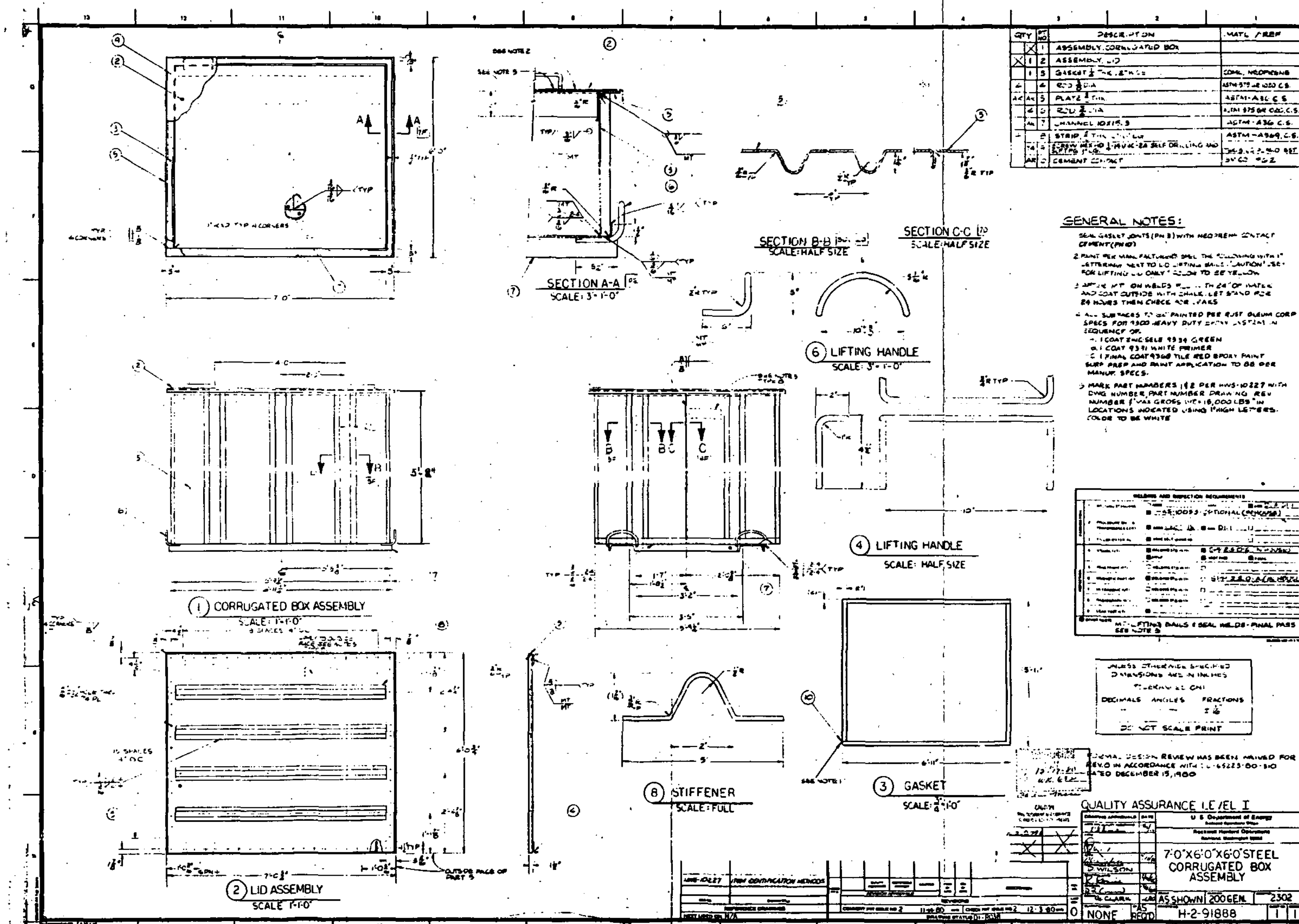
Mechanics Research, Inc., Report C2378, "Engineering Evaluation of the Super Tiger Overpack Designed for the Shipment of Large Quantities of Hazardous Materials."

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

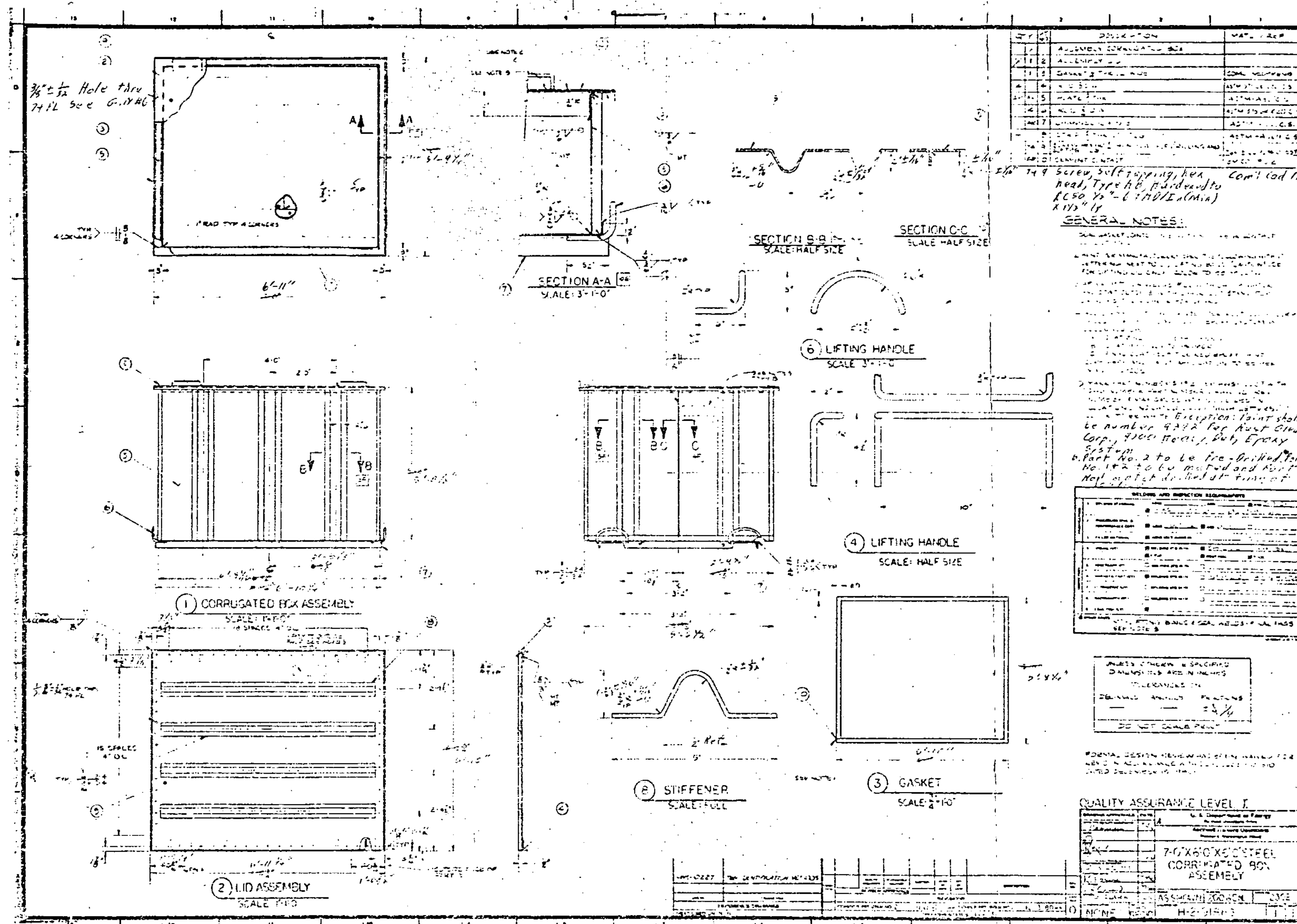
Charles E. MacDonald

Charles E. MacDonald, Chief
Transportation Certification Branch
Division of Fuel Cycle and Material Safety

cc: Richard R. Rawl, DOT
Dr. Donald M. Ross, DOE

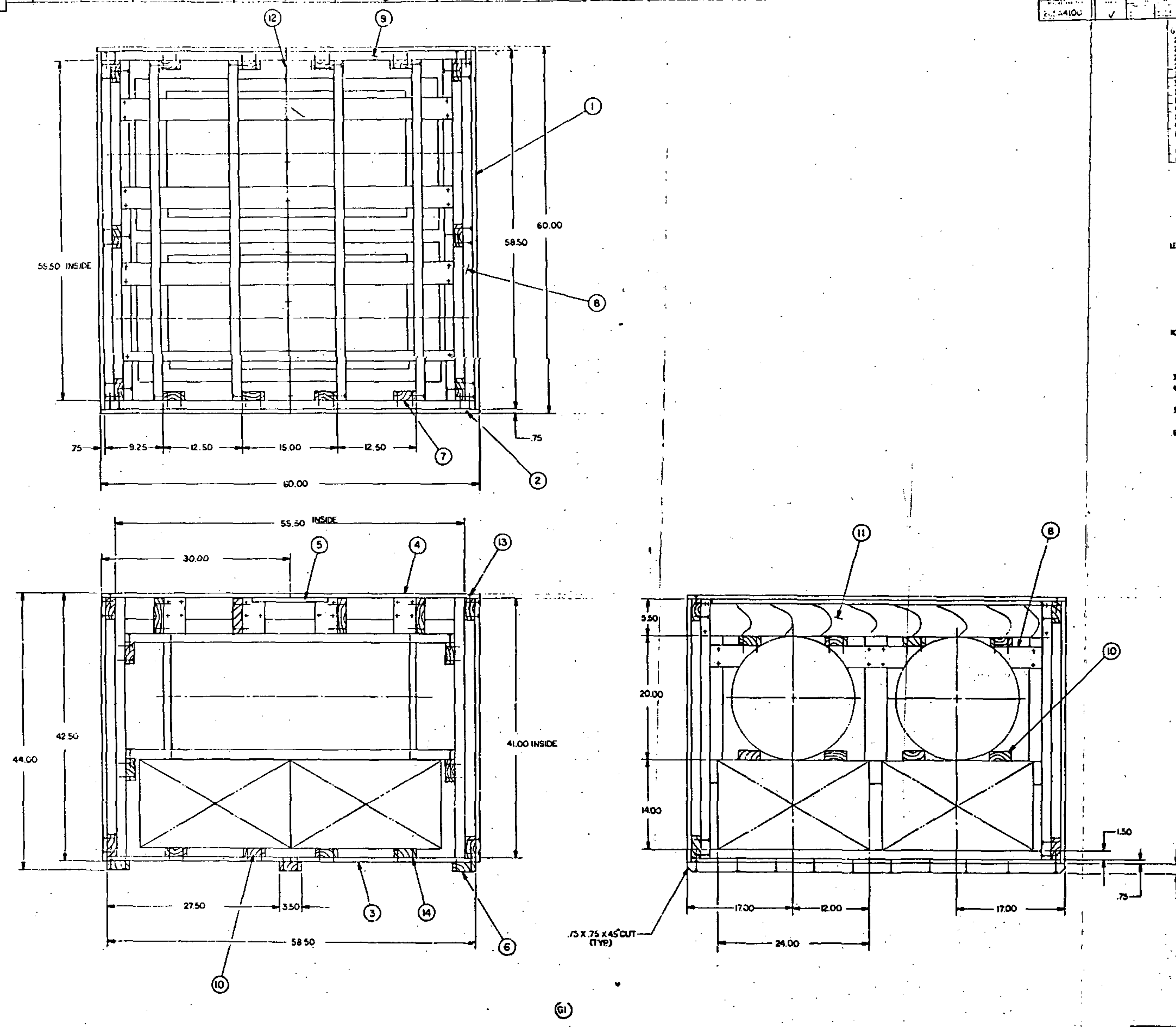


GENERAL NOTES:
CEMENT(PN 10)
24 HOURS THEN CHECK FOR LEAKS
MANUF. SPECS.
SECTION A-A
SCALE: 3" = 1'-0"
SECTION B-B
SCALE: HALF SIZE
SECTION C-C
SCALE: HALF SIZE
6 LIFTING HANDLE
SCALE: 3" = 1'-0"
4 LIFTING HANDLE
SCALE: HALF SIZE
1 CORRUGATED BOX ASSEMBLY
SCALE: 1" = 1'-0"
2 LID ASSEMBLY
SCALE 1" = 1'-0"
8 STIFFENER
SCALE: FULL
3 GASKET
DO NOT SCALE PRINT
DATED DECEMBER 15, 1980
QUALITY ASSURANCE LEVEL I
D. WILSON
G. CLARK
7'-0"X6'-0"X6'-0" STEEL
CORRUGATED BOX
ASSEMBLY
AS SHOWN
200 GEN
2302
NONE
AS REQD
H-2-91888


3/8" ± 1/32 Hole thru 24 PL See G.N. #6
6'-11"
SECTION A-A
SCALE: 3" = 1'-0"
SECTION B-B
SCALE: HALF SIZE
SECTION C-C
SCALE: HALF SIZE
6 LIFTING HANDLE
SCALE: 3" = 1'-0"
4 LIFTING HANDLE
SCALE: HALF SIZE
1 CORRUGATED BOX ASSEMBLY
2 LID ASSEMBLY
8 STIFFENER
SCALE: FULL
3 GASKET
9 Screw, Self tapping, hex head, Type AB, hardened to C50 ... x 1/2" lg
Com'l Grd
GENERAL NOTES:
Exception: Paint shall be number 9392 for Rust Oleum Corp. 9300 Heavy Duty Epoxy System
Part No. 2 to be Pre-Drilled. Part No. 1 & 2 to be mated and Part No. 1 match drilled at time of ...
QUALITY ASSURANCE LEVEL I
7'-0" X 6'-10" X 5'-0" STEEL CORRUGATED BOX ASSEMBLY
NONE

GENERAL SPECIFICATIONS 272E81-28

TUNNEL/FILTERS & MISC. CRATE



QT	PT NO	NAME	DESCRIPTION
2	1	ENDS	.75 x 41.75 x 58.5 ACX PLWD DF.
2	2	SIDES	.75 x 41.75 x 60.0 ACX PLWD DF.
2	3	FLOOR	.75 x 29.25 x 58.5 ACX PLWD DF.
2	4	TOP	.75 x 30.0 x 60.0 ACX PLWD DF.
1	5	SPLICE BRD.	.75 x 12.0 x 52.0 ACX PLWD DF.
3	6	SKID	2 x 8 (NOM) x 60.0 DF.
14	7	SIDE SUPT.	2 x 4 (NOM) x 41.0 DF.
8	8	SIDE SUPT.	2 x 4 (NOM) x 55.5 DF.
4	9	SIDE SUPT.	2 x 4 (NOM) x 58.5 DF.
8	10	BTM. SUPT.	2 x 4 (NOM) x 52.5 DF.
4	11	END. SUPT.	2 x 6 (NOM) x 55.5 DF.
A/R	12	CORRUGATED JOINT FASTNER	.625 STL. McMASTER-CARR 97846A212 OR EQUAL.
A/R	13	NAILS	6D HARDENED DRIVE SCREW NAILS
A/R	14	NAILS	8D HARDENED DRIVE SCREW NAILS

LEGEND:

1. DF. = DOUGLAS FIR
2. PLWD. = PLYWOOD 5 PLY

NOTES:

1. GLUE ALL JOINTS WITH WATER RESISTANT GLUE.
2. CAULK ALL CORNERS, JOINTS & SPLICES WITH WATER RESISTANT CAULKING COMPOUND.
3. LUMBER: CONST. GRADE OR BETTER, DOUGLAS FIR.
4. INTERNAL CRIBBING MEMBERS DO NOT NEED TO BE CONSTRUCTION GRADE LUMBER.
5. INTERNAL CRIBBING MAY VARY FROM BOX TO BOX DUE TO THE VARIOUS SIZES OF MATERIAL THAT MAY BE INSTALLED
6. ALLOW CLEARANCE AROUND ALL COMPONENTS INSTALLED IN BOXES TO ALLOW FOR FOAM TO ENCIRCLE EACH ITEM.

JPL

272E81-28

REQUEST FOR PACKAGE APPROVAL #8, REVISION 0

A. DRAWINGS OR BLUEPRINTS OF THE SYSTEM

Westinghouse Electric Corporation Drawing 1620E43, Sub 3, G025. Reference approved Westinghouse Requests for Package Approval #4 (package) and #7 (contents).

B. TYPE OF SOLID WASTE CONTAINER

Plywood box coated with fiberglass reinforced polyester.

C. SIZE OF SOLID WASTE CONTAINER

Approximately 66" x 68" x 134".

D. RIGGING AND HANDLING APPURTENANCES

Skids per drawing (Section A). One box per overpack, one overpack per truck.

E. DOT SPECIFICATION NUMBER, NRC CERTIFICATE OF COMPLIANCE NUMBER, OR DOE CERTIFICATE OF COMPLIANCE NUMBER OF THE SHIPMENT

A Model 6400 overpack will be used per NRC's approval of Westinghouse's request for exemption, attached.

F. LIMITATION OF THE CONTAINER

Container's limitations will be as described.

G. TYPES AND KINDS OF WASTE TO BE SHIPPED

The waste to be shipped will be as described in 4.b, 4.c, 4.d, and 4.e of the NRC's approval letter (Section E).

H. HEAT OUTPUT OF THE PACKAGE IF GREATER THAN 0.1 w/ft^3

The heat output of this package will not exceed 0.1 w/ft^3.

I. TYPES AND ESTIMATED QUANTITIES OF RADIOACTIVE MATERIALS INCLUDING DOSE RATE

The maximum quantity of material (Plutonium and uranium) in each box shall not exceed quantities specified by the NRC's approval letter (Section E). The dose rates will not exceed 200 mrem/hr as measured at the surface.

J. TYPES AND QUANTITIES OF TOXIC MATERIALS (OTHER THAN RADIOACTIVE COMPONENTS) AS DEFINED IN "DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS"

None of these materials will be present.

K. WEIGHT OF SYSTEM TO BE BURIED

The weight of each empty box is estimated to be 2,800 lbs. The maximum weight of any loaded box will be 5,000 lbs. (2,272 kg). Actual weights will be found on the box.

L. RATE OF INTERNAL OR RADIOLYTIC GAS GENERATION DURING STORAGE

Gas generation will be comparable with that for packages described in previous Westinghouse Approval Requests.

M. QUANTITY OF FISSILE MATERIAL TO BE SHIPPED

The fissile material shipped in each bin will be in the form of plutonium and uranium-235 and will not exceed quantities specified by the NRC's approval letter (Section E).

N. IF TRU WASTE, DOES THE CONTAINER MEET THE 20-YEAR RETRIEVABILITY REQUIREMENTS?

Yes. Reference approved Westinghouse Request for Package Approval #4.

O. TURNAROUND TIME REQUIRED TO RELEASE TRANSPORT EQUIPMENT

The transport equipment should be unloaded and released within a 24-hour period after its arrival.

P. NUMBER OF CONTAINMENT SYSTEMS

The total number of boxes is currently estimated to be 2.

Q. NAME, ADDRESS, AND TELEPHONE NUMBER OF THE SHIPPER

Westinghouse Electric Corporation, Cheswick Avenue, Cheswick, PA 15024. Area Code 412 274-6300.

Technical Requirements: Jack Shoulders, Extension 554 or 655

Shipping/Scheduling: Dave Petrarca, Extension 288 or 655.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

APR 2 1 1981

APR 2 4

SAFEGUARDS & SAFETY

FCTC:RHO
71-6400

Westinghouse Electric Corporation
ATTN: Mr. A. J. Nardi
P. O. Box 355
Pittsburgh, PA 15230

Gentlemen:

Pursuant to 10 CFR Part 71, you are authorized to deliver to a carrier for transport waste which has been packaged in accordance with statements and representations made in your letters dated November 20 and December 15, 1980 and Janaury 12 and 20, and April 10, 1981 subject to the conditions stated below:

1. Model No.: 6400

2. Package Identification No.: USA/6400/B( )F

3. Drawings: Packaging is constructed in accordance with Protective Packaging, Inc., Drawing Nos.: 32106-1, Sheet 1, Rev. F; and 32106, Sheet 2; and either (1) Westinghouse Electric Corporation Drawing No. 2020D08, Sheet 1 and 2, Rev. 0; or (2) Babcock and Wilcox Company Drawing No. 11-D-2130, Rev. 0, as modified by Westinghouse Electric Corporation letter dated January 12, 1981; or (3) Nuclear Packaging, Inc. Drawing No. EG-60-01D, Sheets 1 and 2, Rev. 0, as modified by Westinghouse Electric Corporation letter dated January 20, 1981.

4. Contents:

   a. Large decontaminated equipment waste of such size as not to fit into a 55-gallon drum (with legs or other readily removable appendages removed). Not to exceed 5 grams plutonium within the package.

      Equipment waste surfaces must be decontaminated to a smearable level of no more than 150,000 dpm/100 cm^2 prior to fixation or until successive decontamination cleaning operations do not reduce the smearable contamination levels by more than ten percent. After fixation, equipment waste surfaces must have a smearable level of contamination of no greater than 10,000 dpm/100 cm^2. Outer surfaces must have a smearable level of contamination of no greater than 20 dpm/100 cm^2. Prior to fixing of contamination, large equipment waste must be inspected to insure that: (a) all sharp or protruding objects have been removed or blunted, and (b) pipe caps, gasketed blind flanges, covers, etc., have been installed wherever possible. Following such inspection, the inner surfaces must be fixed with "strip" or "clear" coating. The inner surface(s) may alternatively be fixed with a polurethane foam.

The large equipment waste must be enclosed in a tight fitting box constructed of 1-inch thick plywood. The space between the equipment and the box must be filled with foam and between equipment (1/2" minimum foam thickness).

b. Decontaminated hard waste items, such as equipment, metal cans, tools, etc., shall be double bagged within 12-mil thick PVC, with each bag heat sealed. The total fissile quantity of all the sealed packages in one container must not exceed 200 grams.

Hard waste surfaces must be decontaminated to a smearable level of no more than 150,000 dpm/100 cm^2 prior to fixation or until successive decontamination cleaning operations do not reduce the smearable contamination levels by more than 10 percent. After fixation, hard waste surfaces must have a smearable level of contamination of no greater than 10,000 dpm/100 cm^2. Prior to fixing of contamination, hard waste must be inspected to insure that sharp or protruding objects have been removed or blunted. Following such inspection, the outer surfaces must be fixed with "strip" or "clear" coating. Hard waste items such as furnace shells, muffles, or other items with large cavities not accessible for decontamination must be foaming within the cavities. Surfaces that are not easily accessible, e.g., interiors of small diameter tubing and piping which were in contact with process operations, must be swabbed or immersed in cleaning solution to insure removal of residual material. Open ends of the tubing and piping must be sealed using mechanical fittings.

Two drums containing hard waste items designated as Westinghouse I.D. No. ARD-80-014 and ARD-80-016 which were packaged before March 23, 1981, may be packaged in the following manner:

Wiping and brushing of the components had been completed to remove all residual contamination. The components were individually double bagged within 12-mil thick PVC bagging material. Each bag was heat sealed and assayed. The items were foamed rigidly in place within a DOT Specification 17H 55-gallon steel drum, equipped with a standard drum closure, such that a minimum annular thickness of 2 inches was maintained between the waste packages and inner drum wall. A minimum thickness of 3 inches of foam (foamed in place) was maintained between the bottom of the drum and the lowermost waste package, and between the lid of the drum and the uppermost waste package. The foam has a nominal density of 0.029 g/cc.

The assay values for these drums are as follows:

ARD-80-014 = 45 grams ARD-80-016 = 53 grams

Sealed packages of hard waste must be enclosed in a tight-fitting, 1-inch thick plywood box constructed in accordance with Westinghouse Electric Corporation's Drawing No. 1620E43, Sheets 1, 2, 3, and 4, Rev. 3; or a tight-fitting 3/16" thick corrugated steel box constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91888, Sheet 1, Rev. 0. The space between the packages and the box must be filled with foam to a minimum thickness of 1 inch. Void spaces between the sealed packages must be filled with foam (1/2" minimum foam thickness).

c. Glove box absolute filters with sealed inlet and outlet areas must be double bagged within 12-mil thick PVC, with each bag heat sealed and packaged within DOT Specification 17H or 17C steel drums (maximum size of 55 gallons). Each drum must be lined with a sealed plastic liner and equipped with a standard drum closure. Each drum must not exceed a fissile quantity of 60 grams.

Sealed drums must be enclosed in a tight-fitting 1-inch thick plywood box constructed in accordance with Westinghouse Electric Corporation's Drawing No. 1620E43, Sheets 1, 2, 3, and 4, Rev. 3; or a tight-fitting 3/16" thick corrugated steel box constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91888, Sheet 1, Rev. 0. The space between the drums and the box must be filled with foam to a minimum thickness of 1 inch. Void spaces between drums must be filled with foam (1/2" minimum foam thickness).

d. Soft waste items, such as sheeting, gloves, paper, prefilter media, polyethylene bottles, shoe covers, etc., must be double bagged in 12-mil thick PVC, with each bag heat sealed (bag size must not exceed 22" x 16" x 10") and packaged within DOT Specification 17H or 17C steel drums (maximum size of 55 gallons). Each drum must be lined with a sealed plastic liner and equipped with a standard drum closure. Each drum must not exceed a fissile quantity of 60 grams.

Sealed drums must be enclosed in a tight-fitting 1-inch thick plywood box constructed in accordance with Westinghouse Electric Corporation's Drawing No. 1620E43, Sheets 1, 2, 3, and 4, Rev. 3; or a tight-fitting 3/16" thick corrugated steel box constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91888, Sheet 1, Rev. 0. The space between the drums and the box must be filled with foam to a minimum thickness of 1 inch. Void spaces between drums must be filled with foam (1/2" minimum foam thickness).

e. Liquid waste must be solidified in concrete in a 30-gallon drum which must be sealed in a plastic bag and centered and supported in a DOT Specification 17H or 17C 55-gallon steel drum by absorbent material. The 55-gallon drum must be lined with a sealed plastic liner and equipped with a standard drum closure. Each drum must not exceed a fissile quantity of 60 grams.

Sealed drums must be enclosed in a tight-fitting 1-inch thick plywood box constructed in accordance with Westinghouse Electric Corporation's Drawing No. 1620E43, Sheets 1, 2, 3, and 4, Rev. 3; or a tight-fitting 3/16" thick corrugated steel box constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91888, Sheet 1, Rev. 0. The space between the drums and the box must be filled with foam to a minimum thickness of 1 inch. Void spaces between drums must be filled with foam (1/2" minimum foam thickness).

5. The maximum weight of the contents including secondary packaging, dunnage, shoring and bracing must not exceed 30,000 pounds.

6. Sufficient dunnage, shoring and/or bracing must be utilized to minimize secondary impact of the secondary packaging within the cavity under normal and accident conditions.

7. Protrusions from secondary packaging such as lifting eyes, etc., must be positioned such that they will not contact the cavity walls, or shoring must be provided to prevent puncture of the cavity walls by the protrusions under the normal and accident conditions.

8. Contents must be positioned in the cavity such that the center of gravity of the loaded package is substantially the same as the center of gravity of an empty package.

9. Package Model No. 6400 is exempt from the requirements of 10 CFR §71.42 only for the purpose of making these shipments.

10. This approval supersedes in its entirety approval (MacDonald to Sabo) letter dated January 26, 1981.

11. Expiration Date: December 31, 1981.

REFERENCES

Westinghouse Electric Corporation application dated July 13, 1973.

Supplements Dated: January 12 and 20, and April 10, 1981.

Mechanics Research, Inc., Report C2378, "Engineering Evaluation of the Super Tiger Overpack Designed for the Shipment of Large Quantities of Hazardous Materials."

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Charles E. MacDonald

Charles E. MacDonald, Chief
Transportation Certification Branch
Division of Fuel Cycle and Material Safety

cc: Richard R. Rawl, DOT
Dr. Donald M. Ross, DOE

NOTES:

A-UNITED STATES STL, STRESS TEN OR EQUAL.

B-UNITED STEEL PRODUCTS CO. MONTGOMERY, MINN. OR EQUAL.

C-SEALED AIR CORP. FAIRLAWN, N.J. OR EQUAL.

D-SUPPLIED BY ENGINEER.

1- ADHESIVE SHALL COMPLY WITH THE STANDARD SPECIFICATION FOR ADHESIVES FOR STRUCTURAL LAMINATED WOOD PRODUCTS FOR USE UNDER EXTERIOR (WET USE) EXPOSURE CONDITIONS ASTM-D-2559-70 (ASTM). ADHESIVE TO BE KOPPERS PENACOLITE G-4422A COMPRESSIVE SHEAR STRENGTH OF 2800 PSI, PHENOL RESORCINOL RESIN TYPE, OR EQUAL.

2- FRAMING MEMBERS TO BE SOUTHERN PINE, GRADE NO. 1. TWO INCH THICK (NOMINAL) MATERIAL TO BE KILN DRIED WITH A MAXIMUM MOISTURE CONTENT OF 15%. FOUR INCH BY FOUR INCH (NOMINAL) TO BE SURFACED DRY AND USED AT MAXIMUM MOISTURE CONTENT OF 19%.

3- ALL PLYWOOD TO BE STRUCTURAL I AC AND CONFORM TO U.S. PRODUCT STANDARD PS1 SOFTWOOD PLYWOOD CONSTRUCTION AND INDUSTRIAL 'A' SIDE ON EXTERIOR.

4 CONTAINER TO BE SHIPPED ASSEMBLED WITH GLUING STRIP, TOP PANEL AND FRONT PANEL ATTACHED USING 8d DOUBLE HEADED NAILS, ITEM 43 OR OTHER TEMPORARY FASTENERS FOR EASY REMOVAL. REQ'D QTYS TO BE DETERMINED BY VENDOR.

5- INTERIOR OF BOX TO BE FREE OF PROTRUDING NAILS AND SPLIT LUMBER. REMOVE ALL SPLINTERS AND SAND ALL EDGES OF CONTAINER.

6 AFTER COMPLETION OF CONSTRUCTION CONTAINER TO HAVE A FIBERGLASS-REINFORCED PLASTIC OVERLAY, ITEM 35 ON ALL EXPOSED EXTERIOR SURFACES PER SPECIFICATION E955048. AFTER LOADING AND FINAL ASSEMBLY FRP OVERLAY SHALL BE APPLIED TO BOUNDARY STRIP AND ADJACENT JOINTS TO ACHIEVE CONTINUOUS SEAL.

7- CONTAINER IS DESIGNED TO BE FREE STANDING DURING LOADING OPERATION WITH GLUING STRIP, TOP AND FRONT PANELS REMOVED. GLUING STRIP, TOP AND FRONT PANELS TO BE INSTALLED AFTER LOADING OPERATION USING 16d NAILS, ITEM 40 OR 8d NAILS, ITEM 42 AND ADHESIVE, ITEM 36 SEE NOTE 1. CONTAINER IS NOT TO BE LIFTED OR HOISTED UNTIL COMPLETLY ASSEMBLED.

8 AFTER LOADING, FINAL ASSEMBLY AND FRP OVERLAY, CONTAINER SHALL BE BANDED WITH 2 HORIZONTAL AND 3 VERTICAL BANDS, ITEM 32 SPACED APPROXIMATELY AS SHOWN ALONG THE HEIGHT AND LENGTH RESPECTIVELY, OF THE CONTAINER. EDGE PROTECTORS, ITEM 33 SHALL BE USED AT EDGES UNDER BANDS.

9- CONTAINER DESIGNED FOR VERTICAL LIFTING BY FORKLIFT WITH LIFTING BARS SPACED AT A MINIMUM OF 36 INCHES OR BY A PAIR OF SLINGS INSERTED THROUGH THE OPENINGS IN THE BASE MOST DISTANT FROM CENTER OF CONTAINER. HOIST ARRANGEMENT SHALL ACCOMODATE ANY ECCENTRICITY OF CONTAINER AND INTERNAL LOAD.

10- ALL JOINTS SHALL BE MADE AS FOLLOWS:
   A- APPLY CONTINUOUS LAYER OF ADHESIVE, SEE NOTE 1 ALONG JOINT INTERFACE TO ACHIEVE COMPLETE COVERAGE.
   B- IN ADDITION ALL 2×4, 2×6 AND 4×4 JOINTS TO BE MECHANICALLY JOINED WITH 8d NAILS ITEM 42 16d NAILS ITEM 40 OR LAG BOLTS ITEM 39 AS SHOWN OR NOTED.
   C- ALL PLYWOOD PANELS TO BE FASTENED TO FRAMING MEMBERS WITH 8d NAILS ITEM 42 AND ADHESIVE ITEM 36 SEE NOTE 1. UNLESS NOTED OR SHOWN OTHERWISE.

11 MARK CONTAINER PER E-955048. PURCHASE ORDER NO. WITH DASH AND A 3 DIGIT SERIAL NUMBER APPENDED TO IT, ON BOTH END PANELS, TOP PANEL AND FRONT PANEL. ALSO MARK CONTAINER WITH THE DRAWING AND ASSEMBLY GROUP NUMBER CALCULATED WEIGHTS OF TOP PANEL, FRONT PANEL, BOX AND CONTAINER AND MAXIMUM ALLOWABLE NET WEIGHT AND GROSS WEIGHT ON TOP PANEL AND FRONT PANEL. (LETTER HEIGHT TO BE 2 3/4 MIN)(SEE TABLE 1)

12 PRESSURE TO BE APPLIED TO ALL GLUED JOINTS BY THE USE OF CLAMPS OR BY APPLIED WEIGHTS FOR DURATION OF ADHESIVE SETTING TIME.

13 OVER ALL DIMENSIONS OF CONTAINERS TO BE ±3/8 UNLESS OTHERWISE SPECIFIED. ALL DIMENSIONS APPLY PRIOR TO APPLICATION OF FRP OVERLAY. DIAGONALS MEASURED ON EACH CONTAINER OUTER SURFACE SHALL NOT DIFFER BY MORE THAN 1/2 INCH.

14- SPACING OF NAILS TO BE AT 6 INCH ON CENTERS NOMINAL UNLESS NOTED. TWO ROWS TO BE USED IN 6 INCH MEMBERS AND MUST BE STAGGERED WHEREVER POSSIBLE.

15 VOID SURROUNDING CONSOLE TO BE FILLED WITH POLYURETHANE FOAM BY WESTINGHOUSE. FOAM IS TO HAVE A NOMINAL FREE RISE DENSITY OF 2 LBS/CU. FT.

16 ORIENT CONSOLES ON SIDE WITHIN CONTAINER.

17 NAILS TO BE EITHER RESIN COATED OR RING SHANKED.

18 ALL GAPS AND RECESSES TO BE FILLED WITH A MIXTURE OF POLYESTER RESIN AND SILICA FILLER PRIOR TO FIBERGLASSING.

19 NUMBER OF JOINTS IN PLYWOOD TO BE MINIMIZED. LOCATION OF PLYWOOD JOINTS TO BE SYMMETRICAL ABOUT CENTERLINE OF PANEL, WHERE PRACTICAL. ALL PLYWOOD JOINTS TO BE BACKED BY FRAMING MEMBERS. FACE GRAIN TO BE PARALLEL TO LONGITUDINAL AXIS OF 4×4'S AND DOUBLE 2×6'S.

BILL OF MATERIAL

NOTE	ITEM	NAME DESCRIPTION	PART NO OR REF DWG	MAT'L SPECIFICATION
	01	BOX	[illegible]	
	02	FRONT PANEL	[illegible]	
	03	TOP PANEL	[illegible]	
	04	BOX	[illegible]	
	05	FRONT PANEL	[illegible]	
	06	TOP PANEL	[illegible]	
	07	BOX	[illegible]	
	08	FRONT PANEL	[illegible]	
	09	TOP PANEL	[illegible]	
	10	BOX	[illegible]	
	11	FRONT PANEL	[illegible]	
	12	TOP PANEL	[illegible]	
	13	BOX	1620E43G18	
	14	FRONT PANEL	[illegible]	
	15	TOP PANEL	[illegible]	
	16	BOX	[illegible]	
	17	FRONT PANEL	[illegible]	
	18	TOP PANEL	1620E43G24	
	19	BOX	[illegible]	
	20	FRONT PANEL	1620E43G27	
	21	TOP PANEL	[illegible]	
	22			
	23			
	24	CONSOLE 1,4 [illegible] BLDG #1	540F946	
16	25	CONSOLE 6 BLDG #8	541F920	
16	26	CONSOLE 2,3,4,7,8,10,11,15,30 [illegible]	541F914	
16	27	CONSOLE 5 [illegible] BLDG #8	541F919	
16	28	CONSOLE 14 BLDG #8	[illegible]	
	29	CONSOLE 3 BLDG #1	540F944	
	30	CONSOLE 2,5,18 [illegible]	540F950	
	31			
8 A	32	BAND 1/4 WIDE × [illegible] THK		STL GALV OR ZINC PL
D	33	EDGE PROTECTOR		
	34			
6	35	PLASTIC FIBERGLASS-REINFORCED		E-955048
	36	ADHESIVE		SEE NOTE 1
	37	[illegible]		SEE NOTE 2
	38	WASHER 3/8 [illegible]		STL CAD OR ZINC PL
	39	LAG BOLT 3/8 DIA × 6 LG HEX HD.		STL CAD OR ZINC PL
17	40	NAIL 16d		CARBON STL
17	41	NAIL 6d		CARBON STL
17	42	NAIL 8d		CARBON STL
	43	NAIL FRAMING 8d DBL HD.		CARBON STL
	44	FRAME 2×4 NOM.		SEE NOTE 2
	45	FRAME 2×6 NOM.		SEE NOTE 2
	46	FRAME 4×4 NOM.		SEE NOTE 2
	47			
	48	SHEATHING PLYWOOD		SEE NOTE 3
B	49	WIND BRACING KANT-SAG CAT#5361		STL
	50			
15 C	51	POLYURETHANE FOAM		INSTAPAK 200

TABLE 1

DRAWING AND GROUP NO.	1620E43 G01	1620E43 G05	1620E43 G09	1620E43 G13	1620E43 G17	1620E43 G21	1620E43 G25
FRONT PANEL CALC. WT/LBS.	347	416	336	339	335	245	428
BOX CALCULATED WEIGHT/LBS	1577	1436	1091	1225	1182	945	1606
TOP PANEL CALC WEIGHT/LBS	433	659	502	431	490	340	765
CONTAINER CALC. WT/LBS*	2357	2511	1929	1995	2007	1530	2800
MAX. ALLOWABLE NET WEIGHT/LBS	2643	2489	3071	3005	2993	3470	2200
MAX ALLOWABLE GROSS WEIGHT/LBS	5000	5000	5000	5000	5000	5000	5000

* CONTAINER WEIGHT INCLUDES BOX, TOP & FRONT PANEL & FRP COATING.

REV. STATUS	3	3	3	3	REV.
OF SHEETS	4	3	2	1	SH.

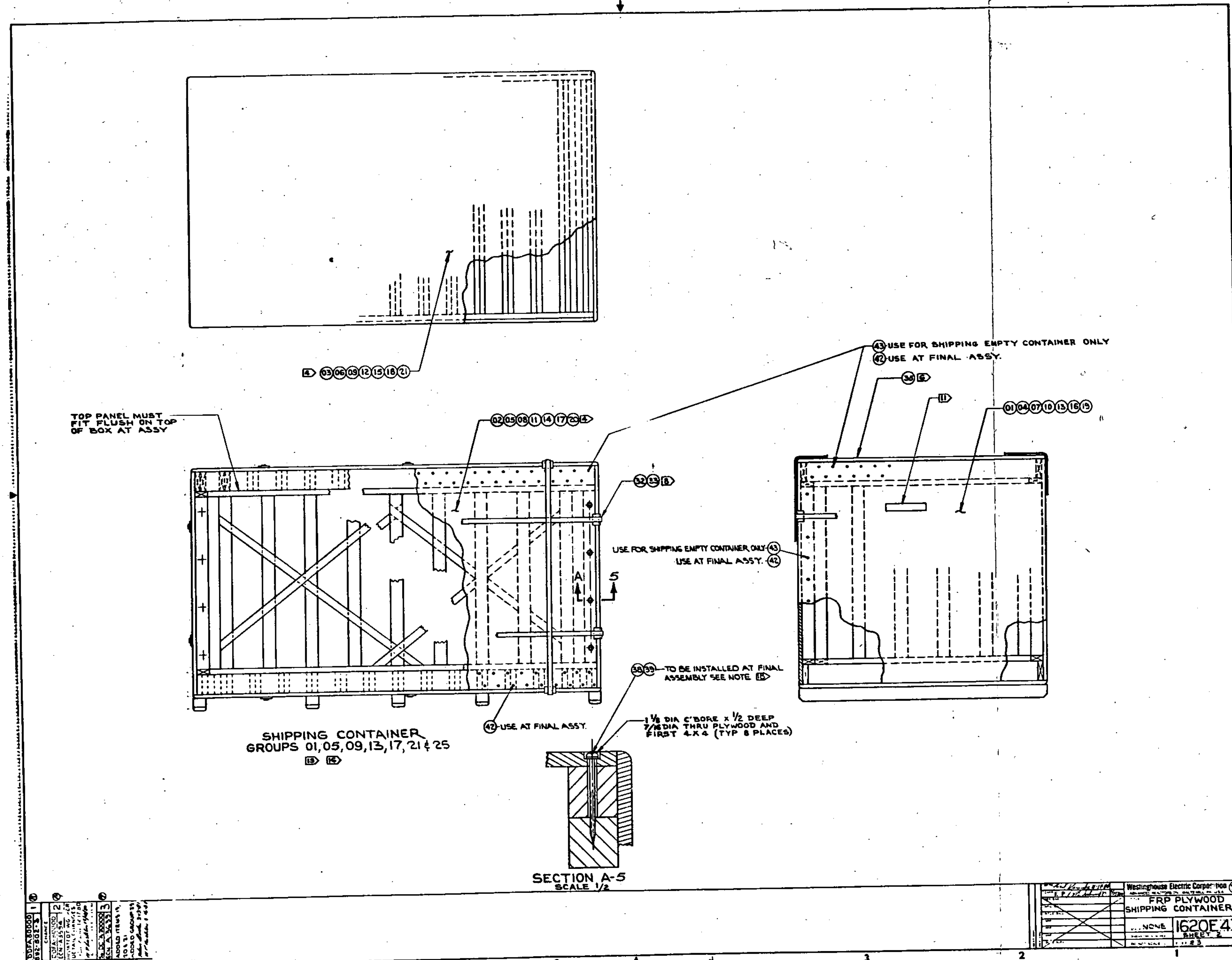
Westinghouse Electric Corporation

FRP PLYWOOD SHIPPING CONTAINER

NONE

1620E43 SHEET 1 OF 4

C-35



TOP PANEL MUST FIT FLUSH ON TOP OF BOX AT ASSY
43 USE FOR SHIPPING EMPTY CONTAINER ONLY
42 USE AT FINAL ASSY.
USE FOR SHIPPING EMPTY CONTAINER ONLY 43
USE AT FINAL ASSY. 42
42 USE AT FINAL ASSY.
38 39 TO BE INSTALLED AT FINAL ASSEMBLY SEE NOTE 15
1 1/8 DIA C'BORE x 1/2 DEEP 7/16 DIA THRU PLYWOOD AND FIRST 4 X 4 (TYP 8 PLACES)
SHIPPING CONTAINER GROUPS 01, 05, 09, 13, 17, 21 & 25
SECTION A-5 SCALE 1/2
Westinghouse Electric Corporation
FRP PLYWOOD SHIPPING CONTAINER
NONE
1620E43
SHEET 2

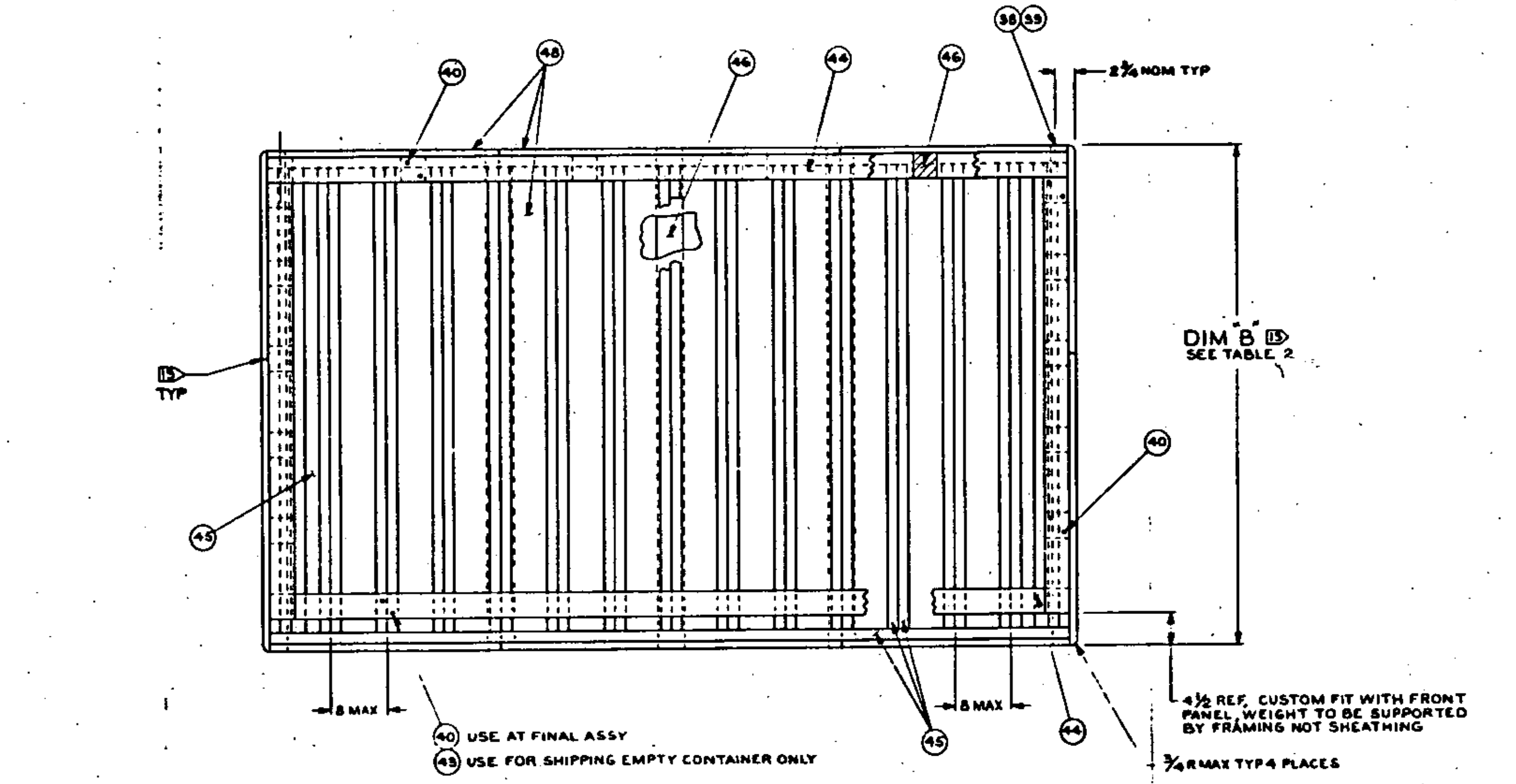
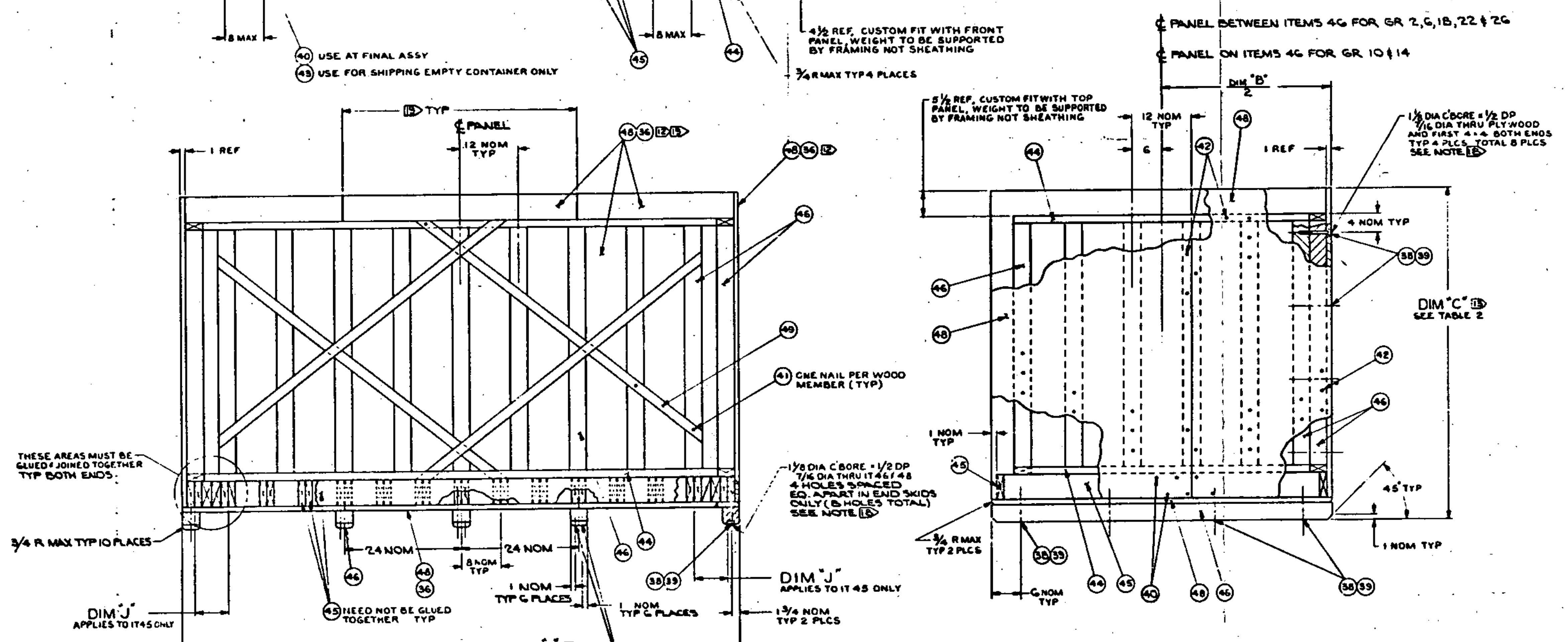


TABLE 2				
GR NO	DIM "A"	DIM "B"	DIM "C"	DIM "J"
02	115	70	68	7½
06	127	70	68	6
10	141	61	54	4½
14	115	73	71	7½
18	118	67½	63	9
22	87	67½	63	9
26	134	61½	65	5



BOX
GROUPS-02,06,10,14,18,22 & 26

1⅛ DIA C'BORE × 1½ DP. 7/16 DIA THRU IT. 46 & 48. 4 HOLES EACH SKID EQ SPACED & STAGGERED APART IN 3 INSIDE SKIDS ONLY. 12 HOLES TOTAL SEE NOTE 16

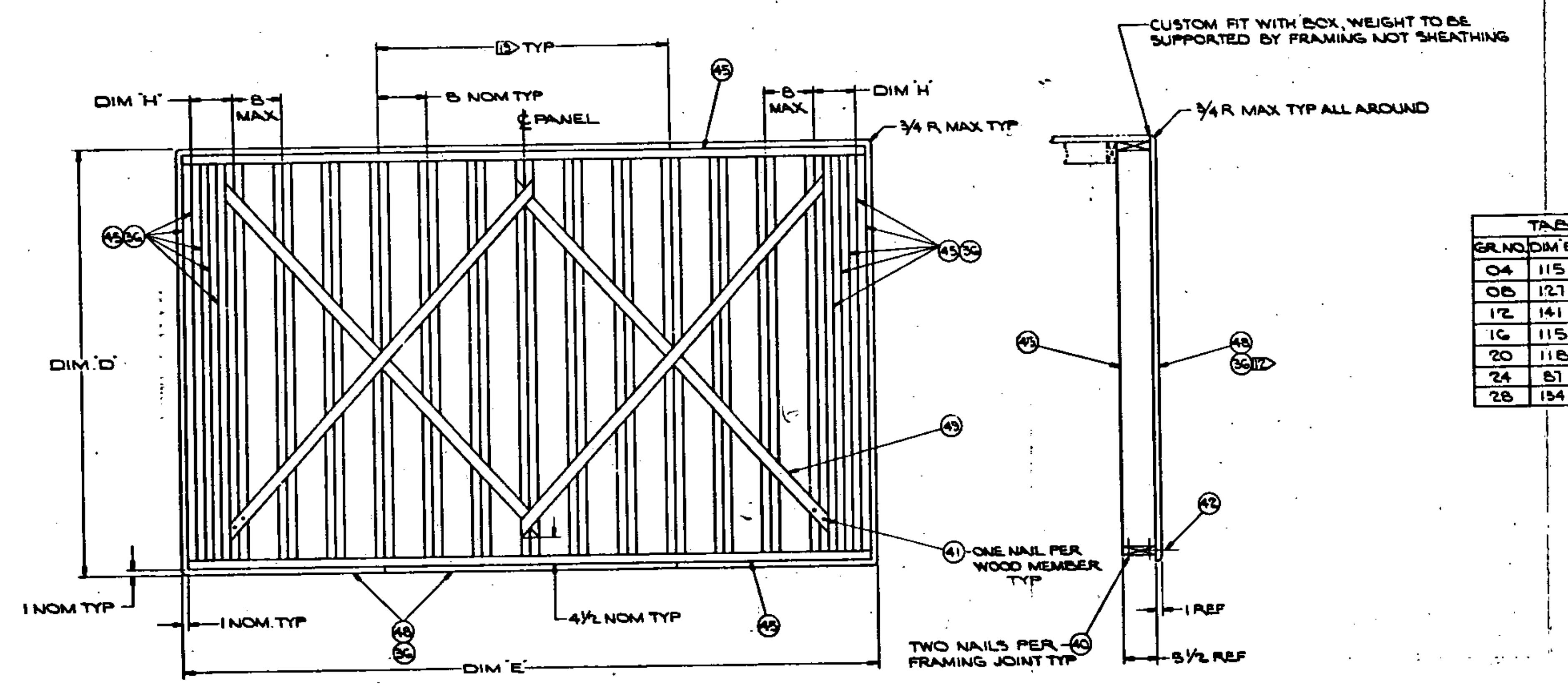
Westinghouse Electric Corporation

FPP PLYWOOD SHIPPING CONTAINER

SCALE NONE

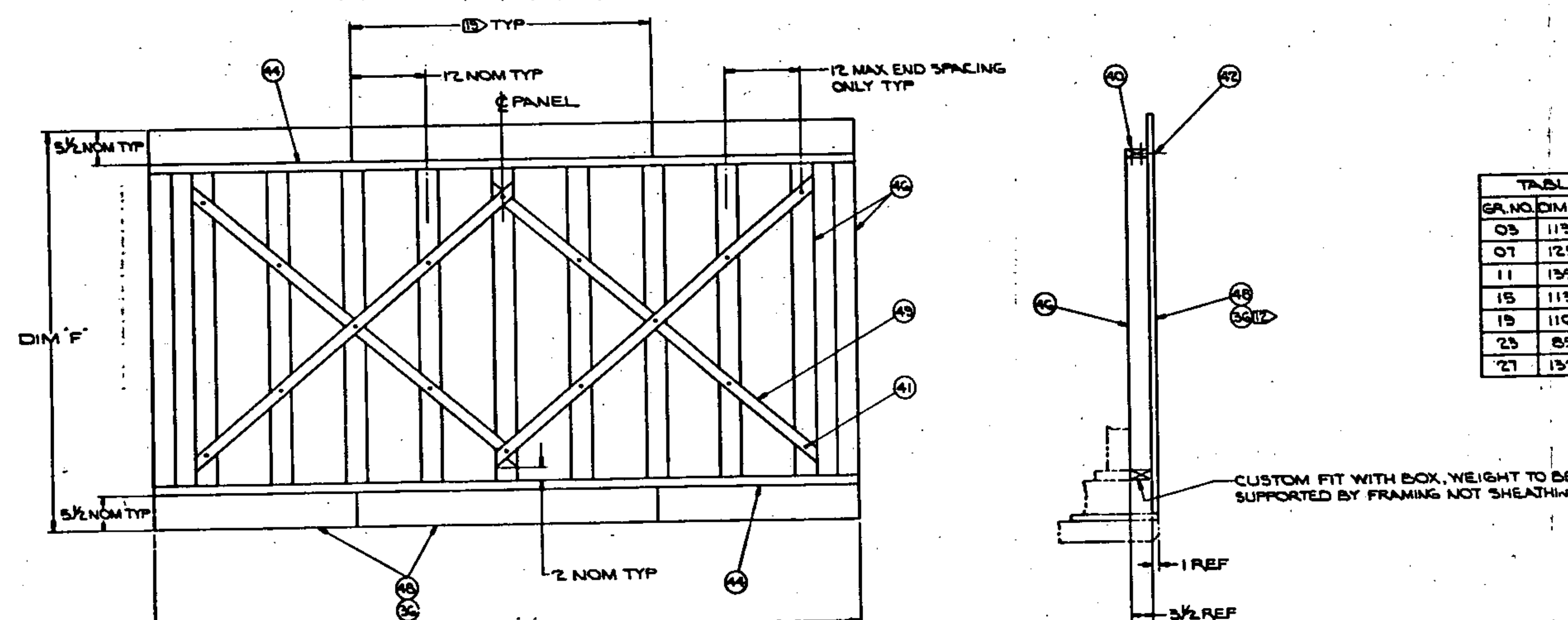
1620E43 SH 3

C-39



TOP PANEL
GROUPS 04,08,12,16,20,24 & 28

TABLE 3			
GR.NO.	DIM 'E'	DIM 'D'	DIM 'H'
04	115	70	7½
08	127	70	6
12	141	61	4½
16	115	73	7½
20	118	67½	9
24	87	67½	9
28	134	67½	9



FRONT PANEL
GROUPS 03,07,11,15,19,23 & 27

TABLE 4		
GR.NO.	DIM 'G'	DIM 'F'
03	113	63½
07	125	63½
11	139	49½
15	113	66½
19	116	58½
23	85	58½
27	132	60½

Westinghouse Electric Corporation
FRP PLYWOOD SHIPPING CONTAINER
NONE
1620F43

EQUIPMENT SPECIFICATION COVER SHEET

WESTINGHOUSE FORM 54725

EQUIPMENT SPECIFICATION	DATED	REVISION NO.	DATED	ORIGINAL ISSUE	SUPERSEDES PREVIOUS REVISIONS
E-955048	7/21/80	3	12/5/80	☐	☒

ATTACHMENTS

PROJECT: Decontamination & Decommissioning of ARD Fuel Laboratories

SHOP ORDER: DDFA-20000

SYSTEM: TRU-Waste Packaging

EQUIPMENT: FRP Plywood Containers

FOR SUPPLIER'S CONVENIENCE

REV. NO.	REVISION ENTERED BY & DATE
1	J.R. Fredrickson 9/30/8.
2	J.R. Fredrickson 10/30/80
3	J.R. Fredrickson 12/15/80

WESTINGHOUSE ELECTRIC CORPORATION
Advanced Reactors Division
P.O. Box 158
Madison, Pennsylvania 15663

APPROVAL

	ORIGINAL ISSUE	REV. 1	REV. 2	REV. 3	REV. 4
Cognizant Design Engineer	J.C. Persang 7-23-80	J.R.F. 9/30/80	J.R.F. 10/30/80	J.R.F. 12/15/80	
DQA Engineer	W.J. Kirkpatrick/JCC 7/23/80	WJK 9/30/80	WJK 10/30/80	WJK 12/15/80	
Cognizant Design Manager	J.C. Cuzman 7/23/80	JCC 9/30/80	JCC 10/30/80	JCC 12/16/80	

FRP PLYWOOD SHIPPING CONTAINER SPECIFICATIONS

1.0 SCOPE

This specification defines the requirements for the fabrication of plywood boxes and for the application of a fiberglass reinforced polyester (FRP) laminate.

2.0 DOCUMENTS

The following documents constitute the specifications for the fabrication of the boxes and for the application of the FRP laminate.

Westinghouse Drawing Number - 1620E43 - FRP Plywood Shipping Container

ASTM D635 - Flammability of self-supporting plastics

ASTM D638 - Tensile properties of plastics

ASTM D790 - Flexural properties of plastics

ASTM D2583 - Indention hardness of plastics by means of Barcol Impressor

ASTM D2584 - Ignition loss of cured reinforced resins

3.0 REQUIREMENTS

3.1 Assembly

Boxes shall be assembled in accordance with 1620E43.
The vendor will supply all material.

3.2 Materials

3.2.1 Resin

Resin shall be flame resistant polyester suitable for spray up application, such as CO-RESIN 1664A, (Interplastic Corporation, Minneapolis, Minn.) or equivalent. To facilitate visual inspection of lamination quality, no fillers, pigments, or dyes permitted, except as necessary to obtain specified flame resistance.

3.2.2 Fiberglass

The fiberglass reinforcement shall be non-continuous roving, with a red tracer. Strand length shall be 0.5 to 2.0 inches. Fiberglass mat and hand lay-up can be used to finish exposed edges.

3.3 FRP Laminate

3.3.1 Application

The FRP laminate shall be applied to the outside surfaces of the partially assembled box (including the skids), leaving an exposed band of plywood 5 inches wide at the top edge and each front vertical edge of the end panels and the top edge of the back panel. FRP laminate shall be applied to the outside surface of the front and top panel except for a 5-inch band of bare exposed plywood around the perimeter of each panel. All plywood mating surfaces shall be free of overspray. The intent for clean plywood surfaces is to maximize adhesion of glued panels and final application of the FRP seal.

3.3.2 Thickness

The FRP laminate shall be 0.125 inches minimum thickness throughout, including exterior edges, except 10% of the flat surfaces may be 0.094 inches minimum thickness.

3.3.3 Finish

The finished laminate shall be smooth, continuous and free of cracks, crazing, and sharp projections and exposed fibers. There shall be no leak paths to the plywood surface. Air bubbles and other voids larger than 0.125 inches diameter shall be voided. Wood filler strips may be added where necessary to meet this requirement.

3.3.4 Non-Slip Top Surface

Spray top surface of box with a light coat of resin and distribute approximately one (1) quart of fine gravel into wet resin, to provide a non-slip surface.

3.3.5 Physical Properties

The FRP shall have the following physical properties:

a) Barcol Hardness	30 Min. per ASTM D2583
b) Ultimate Tensile Strength	9,000 psi min. per ASTM D638
c) Flexural Strength	16,000 psi min. per ASTM D790
d) Fiberglass Content	28-34% per ASTM D2584
e) Flammability	Self-extinguishing per ASTM D635 or flame spread classification of 25 maximum per ASTM E-84.

3.4 Skids

The ends of all 4 x 4 skids shall be approximately flush with the sides of the box.

3.5 Pre-Production Sample

Prior to the start of production, the vendor shall fabricate one (1) box, using production processes and materials. This sample box will be evaluated by Westinghouse for compliance with specifications. After a sample has been accepted, the vendor may proceed with production.

3.6 Notification of Manufacture and Tests

Manufacturing processing and tests may be audited by Westinghouse. The vendor shall notify the purchasing agent three (3) days prior to scheduled start date of fabrication processes and tests.

3.7 Test Specimens

A test panel shall be required for initial qualification and each time any lot of resin or hardener is changed. This panel shall be one (1) foot square, minimum of 0.125 thickness of the FRP combination used. It shall be prepared by spray-up application to a piece of teflon, saran, metal or other surface, in such a manner as to not introduce foreign agents into the specimen.

3.8 Identification

Identification and weight information specified on drawing shall be printed on box surfaces after application of FRP laminate at indicated locations. A coat of clear polyester resin shall be applied over all lettering.

4.0 QUALITY RECORDS

4.1 Records

Each lot of boxes shall be accompanied by the following records.

a) The vendors certification that the materials used meet the requirements of the specification. For Items 3.3.5b, c, d, e component manufacture certifications are sufficient.

b) The manufacturers name, stock number and batch or lot number for all materials used, including resins, flame retardants, fiberglass and catalysts.

The raw materials certification and test results obtained by the manufacturer on all lots shall be maintained in a retrievable manner by the manufacturer for a period of at least five (5) years or these records may be sent to Westinghouse for retention. A lot of boxes is defined as all units with a single lot of FRP coating.

4.2 Procedures

The vendor shall provide the following non-destructive testing and special inspection procedures:

a) Barcol hardness test

b) FRP thickness measurement

c) Inspection of FRP finish

4.3 Acceptance

Westinghouse acceptance will be based on dimensional inspection, visual examination and on destructive and non-destructive tests. At Westinghouse prerogative, test specimens may be cut from test panels that the vendor would be required to furnish. The pre-production sample box required for Section 3.0 will be used as standard for finish and workmanship. Failure to meet the requirements of the drawings and specifications will be cause for rejection of an item or lot, as indicated by the type of failure.

5.0 PACKAGING

Good commercial handling and shipping methods shall be used to assure damage-free delivery of the product.

INSPECTION FORM

REFERENCE:

1620E43

ITEM	SPECIFICATION	INSPECTION ENTRY	INSPECTED BY
1	Quantity delivered		
2	Non-slip surface per Para. 3.3.4 of E-955048		
3	Top and front panel temporarily fastened		
4	Overall quality of workmanship		
5	Purchase order, drawing, group and serial numbers and weight information of appropriate drawing and per Para. 3.8 of E-955048		
6	Test panel furnished by vendor.		
7	Skids are approximately flush.		
8	Barcol hardness 30 minimum ASTM D2583.		
9	Fiberglass laminate applied per Para. 3.3.1 of E-955048.		
10	Material meets requirements of E-955048. Vendors certification furnished. a) Fiberglass lot number b) Resin lot number c) Hardener lot number		
11	Air bubbles and voide >0.125 and finish limited per 3.3.3 of E-955048.		
12	Fiberglass thickness 0.125 inch minimum except 10% of surface may be 0.094 inch per 3.3.2 of E-955048.		
	VENDORS CERTIFICATION		
13	Tensile strength 9,000 psi. min. ASTM D638		
14	Flexural strength 16,000 psi. min. ASTM D790		
15	Glass Content 28-34 w/o ASTM D2584		
16	Flammability ASTM D635		
17	Certificate of Compliance		

REQUEST FOR PACKAGE APPROVAL NO. 5, REV. 0

A. DRAWINGS OR BLUEPRINTS OF THE SYSTEM

1. DOT Specification 17H and 17C containers, 55 gallon drums.

2. Argonne National Laboratory's Drawing CS-2273, "Waste Storage Bin M-III."

B. TYPE OF SOLID WASTE CONTAINERS

1. Steel drum, 55 gallon capacity.

2. Steel box.

C. SIZE OF SOLID WASTE CONTAINERS

1. Approximately 24" diameter x 35" high.

2. Approximately 50-3/8" x 58-3/8" x 72-3/8".

D. RIGGING AND HANDLING APPURTENANCES

1. None - Standard 55 gallon drums.

2. Lifting strap per drawing (A.2).

E. DOT SPECIFICATION, NUMBER, NRC CERTIFICATION OF COMPLIANCE NUMBER, OR DOE CERTIFICATE OF COMPLIANCE NUMBER OF THE SHIPMENT

1. DOT Specification 17H (49CFR178.118), DOT Specification 17C (49CFR178.115).

2. DOT Specification 7A per Mound Laboratory Report MLM 2228.

NOTE: Each container may be shipped either in a closed trailer or in a Model 6272 overpack. The drums shipped in the overpack would be removed from the bins and the bins would be returned to Westinghouse.

F. LIMITATIONS OF THE CONTAINERS

As described.

G. TYPES AND KINDS OF WASTE TO BE SHIPPED

The waste to be packaged in these containers shall satisfy the requirements for Non-TRU materials (<10 nanocuries per gram of matrix) and for low specific activity (LSA) materials per 10CFR71.4(g).

The waste items will either be placed inside plastic bags or their contaminated inner surfaces will be sealed with tape, plastic, flanges, caps, etc., which will be sealed within the containers identified in Section A. Combustible and noncombustible waste items will be packaged together to maximize packaging.

H. HEAT OUTPUT OF THE PACKAGE IF GREATER THAN 0.1 W/FT^3

The heat output of the package will not exceed 0.1 w/ft^3.

I. TYPES AND ESTIMATED QUANTITIES OF RADIOACTIVE MATERIALS INCLUDING DOSE RATE

The maximum quantity of material (plutonium and uranium) in each package shall not exceed quantities defined by the non-TRU limits. The dose rates will not exceed 200 mrem/hr as measured at the surface.

J. TYPES AND QUANTITIES OF TOXIC MATERIALS (OTHER THAN RADIOACTIVE COMPONENTS) AS DEFINED IN "DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS"

None of these materials will be present.

K. WEIGHT OF SYSTEM TO BE BURIED

Actual weights will be found on the package. However, maximum package weights are:

1. 840 pounds (382 Kgs)
2. 3000 pounds (1363 Kgs)

L. RATE OF INTERNAL OR RADIOLYTIC GAS GENERATION DURING STORAGE

Gas generation rates were calculated (by RHO) for previous Requests for Package Approval (#1, #2 and #3).

M. QUANTITY OF FISSILE MATERIAL TO BE SHIPPED

A maximum quantity of radioactive material as described in Section I will be shipped in the form of plutonium and uranium-235. This quantity will not exceed 200 grams of fissile material.

N. IF TRU WASTE, DOES THE CONTAINER MEET THE 20-YEAR RETRIEVABILITY REQUIREMENTS?

Does not apply.

O. TURNAROUND TIME REQUIRED TO RELEASE TRANSPORT EQUIPMENT

The transport equipment should be unloaded and released within a 24-hour period after its arrival.

P. NUMBER OF CONTAINMENT SYSTEMS

The total number of 17H and 17C drums is currently estimated to be 100.

The total number of Argonne steel boxes is currently estimated to be 6.

Q. NAME, ADDRESS AND TELEPHONE NUMBER OF THE SHIPPER

Westinghouse Electric Corporation, Cheswick Avenue, Cheswick, PA 15024, Area Code (412) 274-6300, technical requirements - Jack Shoulders on Extensions 554, or 655, shipping/scheduling - Dave Petrarca on Extensions 288 or 655.

REQUEST FOR PACKAGE APPROVAL NO. 6, REV. 0

A. DRAWINGS OR BLUEPRINTS OF THE SYSTEM

1. Westinghouse Drawing No. 2044F14, "Non-TRU Shipping Container."
2. Mound Laboratory Drawing No. AYD 750375, "TRU Waste Plywood Box Details."

B. TYPE OF SOLID WASTE CONTAINERS

1. Plywood box.
2. Plywood box.

C. SIZE OF SOLID WASTE CONTAINERS

1. Approximately 48" x 85" x 72".
2. Approximately 48" x 84" x 52-1/2".

D. RIGGING AND HANDLING APPURTENANCES

1. Skidded per drawing (A.1).
2. Skidded per drawing (A.2).

E. DOT SPECIFICATION, NUMBER, NRC CERTIFICATION OF COMPLIANCE NUMBER, OR DOE CERTIFICATE OF COMPLIANCE NUMBER OF THE SHIPMENT

1. Strong, tight package - No DOT Specification.
2. Strong, tight package - (DOT Specification 7A only if fiberglassed. Ref. Rocky Flats Report RFP-2460).

NOTE: Containers to be shipped in a closed trailer.

F. LIMITATIONS OF THE CONTAINERS

As described.

G. TYPES AND KINDS OF WASTE TO BE SHIPPED

The waste to be packaged in these containers shall satisfy the requirements for Non-TRU materials (<10 nanocuries per gram of matrix) and for low specific activity (LSA) materials per 10CFR71.4(g).

G. TYPES AND KINDS OF WASTE TO BE SHIPPED (cont'd)

The waste items will either be placed inside plastic bags or their contaminated inner surfaces will be sealed with tape, plastic, flanges, caps, etc., which will be sealed within the containers identified in Section A. Combustible and noncombustible waste items will be packaged together to maximize packaging.

H. HEAT OUTPUT OF THE PACKAGE IF GREATER THAN 0.1 W/FT^3

The heat output of the package will not exceed 0.1 w/ft^3.

I. TYPES AND ESTIMATED QUANTITIES OF RADIOACTIVE MATERIALS INCLUDING DOSE RATE

The maximum quantity of material (plutonium and uranium) in each package shall not exceed quantities defined by the non-TRU limits. The dose rates will not exceed 200 mrem/hr as measured at the surface.

J. TYPES AND QUANTITIES OF TOXIC MATERIALS (OTHER THAN RADIOACTIVE COMPONENTS) AS DEFINED IN "DANGEROUS PROPERTIES OF INDUSTRIAL MATERIALS"

None of these materials will be present.

K. WEIGHT OF SYSTEM TO BE BURIED

Actual weights will be found on the package. However, maximum package weights are:

1. 4000 pounds (1818 Kgs)
2. 5000 pounds (2273 Kgs)

L. RATE OF INTERNAL OR RADIOLYTIC GAS GENERATION DURING STORAGE

Gas generation rates were calculated (by RHO) for previous Requests for Package Approval (#1, #2 and #3).

M. QUANTITY OF FISSILE MATERIAL TO BE SHIPPED

A maximum quantity of radioactive material as described in Section I will be shipped in the form of plutonium and uranium-235. This quantity will not exceed 200 grams of fissile material.

N. IF TRU WASTE, DOES THE CONTAINER MEET THE 20-YEAR RETRIEVABILITY REQUIREMENTS?

Does not apply.

O. TURNAROUND TIME REQUIRED TO RELEASE TRANSPORT EQUIPMENT

The transport equipment should be unloaded and released within a 24-hour period after its arrival.

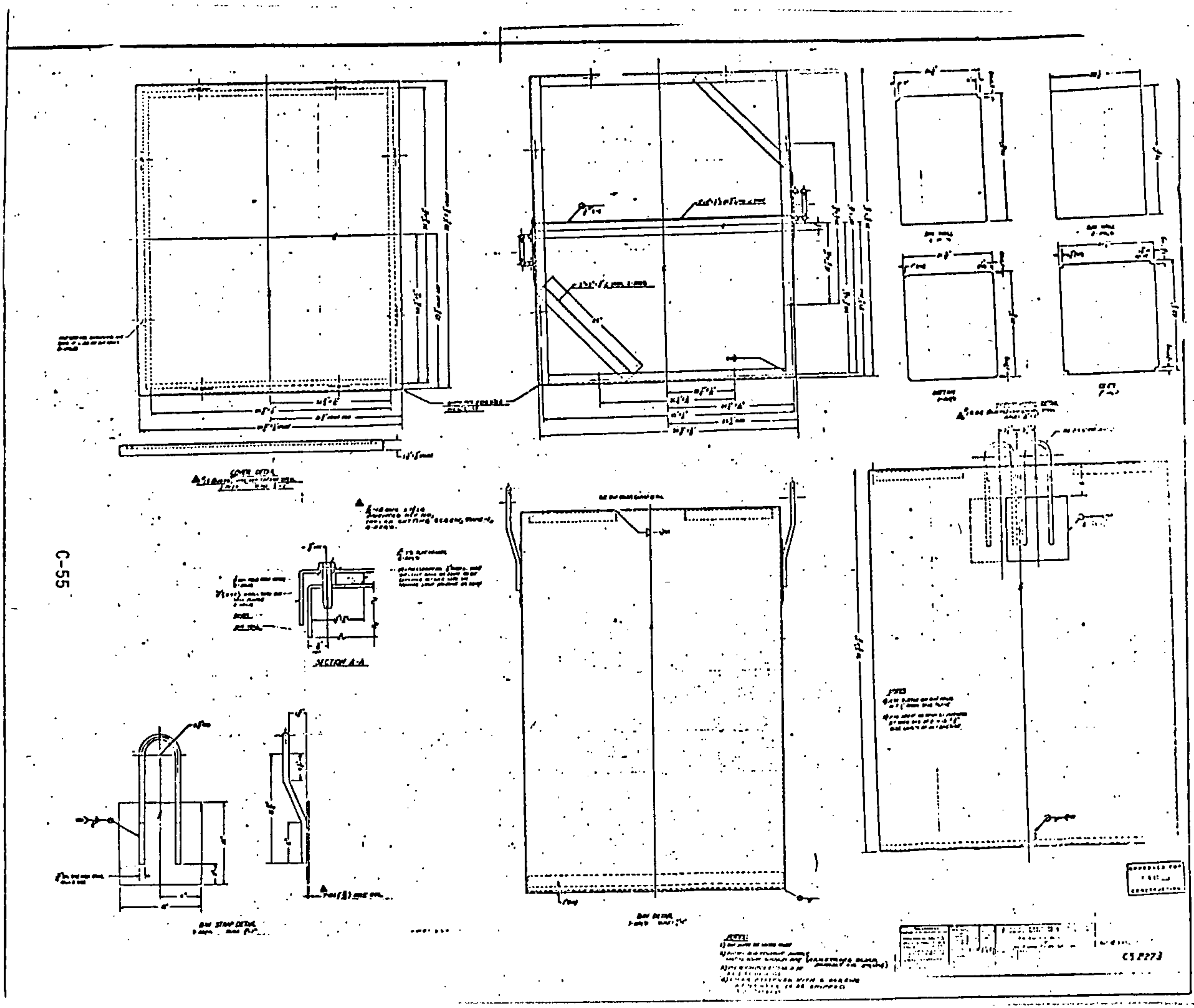
P. NUMBER OF CONTAINMENT SYSTEMS

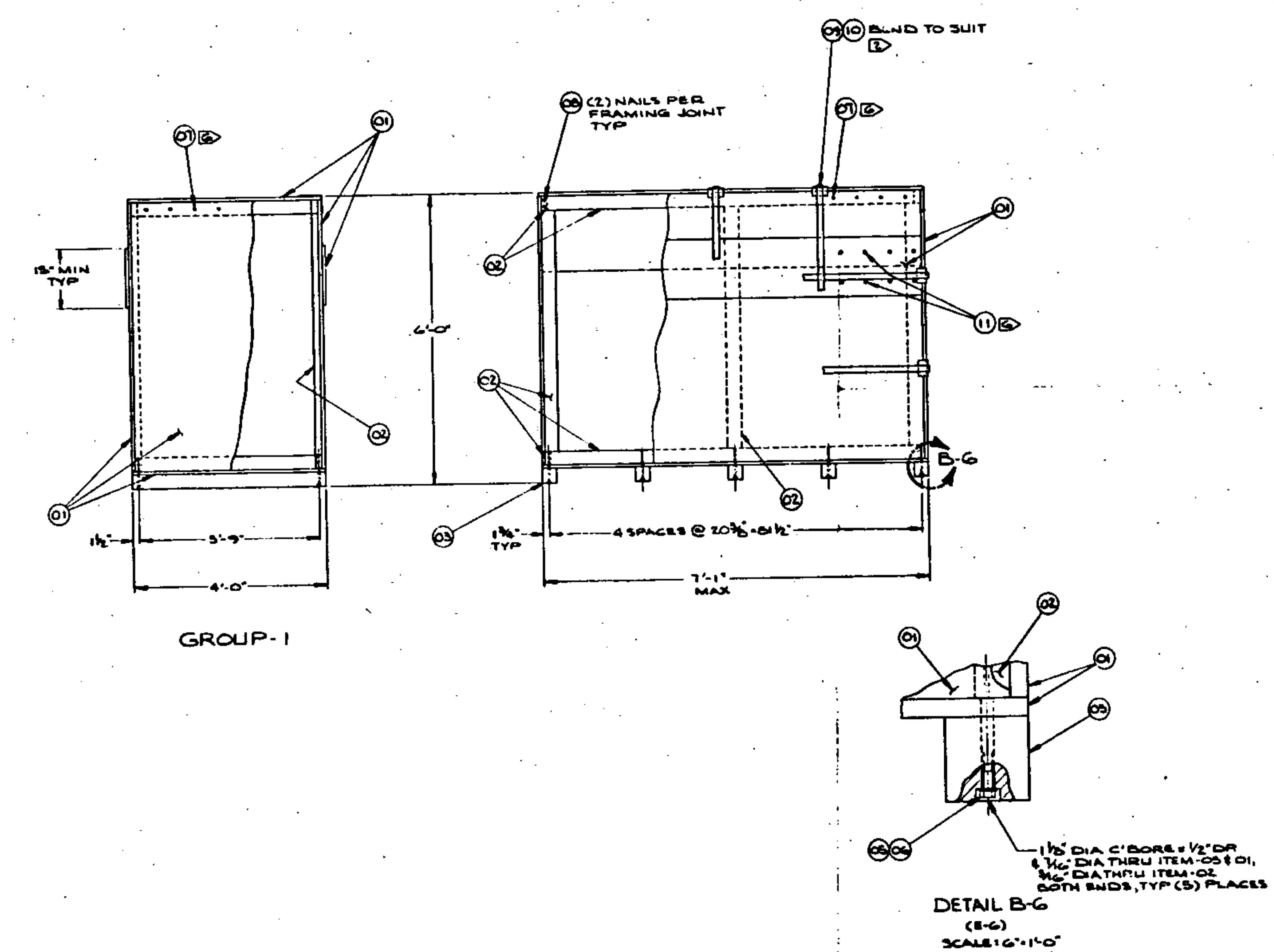
The total number of Westinghouse plywood boxes is 5.

The total number of Mound Laboratory plywood boxes is currently estimated to be 5.

Q. NAME, ADDRESS AND TELEPHONE NUMBER OF THE SHIPPER

Westinghouse Electric Corporation, Cheswick, Avenue, Cheswick, PA 15024, Area Code (412) 274-6300, technical requirements - Jack Shoulders on Extensions 554, or 655, shipping/scheduling - Dave Petrarca on Extensions 288 or 655.


SECTION A-A



BILL OF MATERIAL

NOTE	ITEM	NAME-DESCRIPTION	PART NO OR REF DWG	MAT'L SPECIFICATION	GR 1	GR 2	GR 3	GR 4
	01	SHEATHING, ¾ PLYWOOD		SEE NOTE-A	AR			
	02	FRAME, 2×4 NOM.		SEE NOTE-B	AR			
	03	BASE, 4×4 NOM.		SEE NOTE-B	5			
	04	ADHESIVE		SEE NOTE-C	AR			
	05	LAG BOLT .38 DIA × 6.00 LG HEX HD.		STL, CAD OR ZINC PL	10			
	06	WASHER .38 FLAT MED.		STL, CAD OR ZINC PL	10			
	07	NAIL, 6d		CARBON STL, RESIN COATED	AR			
	08	NAIL, 8d		CARBON STL, RESIN COATED	AR			
2 D	09	BAND, 1.25 WIDE × .031 THK, OR .50 WIDE × .020		STL, GALV OR ZINC PL	AR			
E	10	EDGE PROTECTOR			AR			
	11	NAIL, 3d SMOOTH BOX		CARBON STL	AR			
F	12	SEALANT			AR			

NOTES:

A. ALL PLYWOOD TO BE STRUCTURAL II C-D & CONFORM TO U.S. PRODUCT STANDARD PS1 SOFTWOOD PLYWOOD CONSTRUCTION & INDUSTRIAL, OR EQUAL.

B. GRADE NO 2 DOUGLAS FIR SOUTH OR EQUAL SURFACED DRY OR SURFACED GREEN USED AT 19% MOISTURE CONTENT.

C. ADHESIVE SHALL COMPLY WITH THE STANDARD SPECIFICATION FOR ADHESIVES FOR STRUCTURAL LAMINATED WOOD PRODUCTS FOR USE UNDER EXTERIOR (WET USE) EXPOSURE CONDITIONS ASTM-D-2559-70 ADHESIVE TO BE KOPPERS PENACOLITE G-4422A COMPRESSIVE SHEAR STRENGTH OF 2800 PSI, PHENOL RESORCINOL RESIN TYPE, OR EQUAL.

D. UNITED STATES STEEL, STRESS TEN OR EQUAL.

E. SUPPLIED BY ENGINEER.

F. DOW CORNING SILICONE RUBBER SEALANT OR EQUAL.

1. INTERIOR OF BOX TO BE FREE OF PROTRUDING NAILS & SPLIT LUMBER. REMOVE ALL SPLINTERS & SAND ALL EDGES OF CONTAINER.

2. AFTER LOADING & FINAL ASSEMBLY, CONTAINER SHALL BE BANDED WITH 2 HORIZONTAL & 5 VERTICAL BANDS (ITEM-09) SPACED APPROXIMATELY EQUALLY (AVOID SK'DS) ALONG THE HEIGHT & LENGTH RESPECTIVELY OF THE CONTAINER. EDGE PROTECTORS (ITEM-10) SHALL BE USED AT EDGES UNDER BANDS.

3. ALL JOINTS SHALL BE MADE AS FOLLOWS:
   a. APPLY CONTINUOUS LAYER OF ADHESIVE (ITEM-04) ALONG JOINT INTERFACE TO ACHIEVE COMPLETE COVERAGE. (SEE GENERAL NOTE-C ABOVE).
   b. IN ADDITION ALL 2X4 & 4X4 JOINTS TO BE MECHANICALLY JOINED WITH 8d NAILS (ITEM-08) OR LAG BOLTS (ITEM-05) AS SHOWN OR NOTED.
   c. ALL PLYWOOD PANELS TO BE FASTENED TO FRAMING MEMBERS WITH 6d NAILS (ITEM-07) AND ADHESIVE (ITEM-04)

4. PRESSURE TO BE APPLIED TO ALL GLUED JOINTS BY THE USE OF CLAMPS OR BY APPLIED WEIGHTS FOR DURATION OF ADHESIVE SETTING TIME.

5. OVERALL DIMENSIONS OF CONTAINER TO BE ± 3/16 UNLESS OTHERWISE SPECIFIED. DIAGONALS MEASURED ON EACH CONTAINER OUTER SURFACE SHALL NOT DIFFER BY MORE THAN ½ INCH.

6. SPACING OF NAILS TO BE AT 6 INCH ON CENTERS NOM. UNLESS NOTED.

7. ALL JOINTS FORMED BY PLYWOOD WITH PLYWOOD SHALL BE SEALED WITH SEALANT (ITEM-12) OR EQUAL.

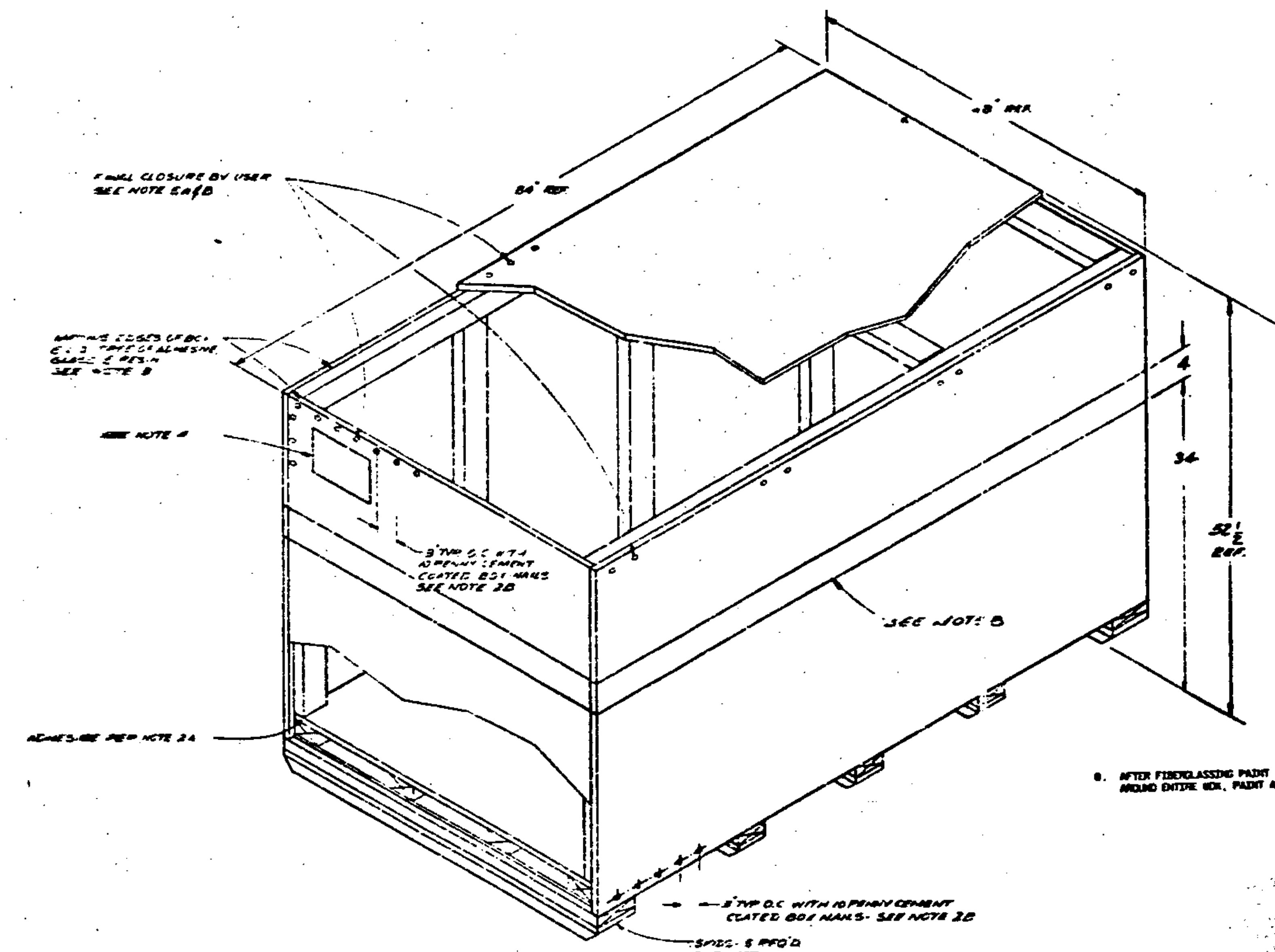
8. MAXIMUM WEIGHT OF CONTAINER & CONTENTS NOT TO EXCEED 4000 LBS.

9. LIFTING OR MOVING OF A PARTIALLY ASSEMBLED, LOADED CONTAINER MUST BE EVALUATED ON A CASE BY CASE BASIS.

Westinghouse Electric Corporation

NON-T R U SHIPPING CONTAINER

2044F14



NOTES.

1. BOX DIMENSIONS BEFORE FIBERGLASSING:

   OUTSIDE: 84 L x 48 W x 52 D = 121 FT^3
   INSIDE: 82.5 L x 43.5 W x 44 D = 91 FT^3

   ALL DIMENSIONS ARE IN INCHES, EXCEPT AS NOTED.

2. ASSEMBLE BOX AS FOLLOWS:

   A. APPLY ELASTOMERIC CONSTRUCTION ADHESIVE (B. F. GOODRICH PL-200 OR APPROVED EQUIVALENT) IN A CONTINUOUS BEAD OF 1/4 INCH MINIMUM DIAMETER ALL AROUND 3/4 INCH BOTTOM PANEL AND ON BOTH SIDE EDGES OF END PANELS. APPLY A BEAD OF ADHESIVE BETWEEN VERTICAL END STRUTS AND END PANELS. REMOVE EXCESS ADHESIVE FROM OUTSIDE OF BOX.

   B. FASTEN PANELS USING 10 PENNY CEMENT-COATED BOX NAILS OR 2 INCH PLASTIC-COATED STAPLES WITH 3 INCH MAXIMUM SPACING. FASTENERS SHALL BE DRIVEN FLUSH TO 1/16 IN. MAXIMUM BELOW SURFACE. STAPLE CROWN SHALL CROSS GRAIN OF FIRST PLY AT NOT LESS THAN A 40° ANGLE. INTERIOR OF BOX SHALL BE FREE OF PROTRUDING FASTENERS AND SPLIT LUMBER.

   C. EDGES OF SIDE AND END PANELS SHALL BE FLUSH TO 1/16 INCH MAXIMUM ABOVE BOTTOM OF BOX.

3. FIBERGLASS BOX AND ASSEMBLE SKIDS PER SPA740082. MATING EDGES OF BODY AND LID SHALL BE FREE OF FIBERGLASS AND MEASURABLE RESIN OVERSPRAY. BOX EDGES MAY BE BROKEN 3/4 MAXIMUM RADIUS OR CHAMFER TO FACILITATE FIBERGLASSING.

4. DURABLY AND LEGIBLY MARK MANUFACTURER'S NAME OR SYMBOL AND DATE OF MANUFACTURE, 2 PLACES ON OPPOSITE ENDS OF BOX USING CHARACTERS AT LEAST 1/4 INCH HIGH (MAY BE PAPER LABEL WITH RESIN COVERCOAT).

5. FINAL CLOSURE:

   A. USER SHALL MAKE FINAL BOX CLOSURE WITH MATERIALS SPECIFIED IN NOTE 2. APPLY ADHESIVE ALL AROUND TOP EDGES OF VERTICAL 3/4 INCH PANELS. IN ADDITION TO 10 PENNY NAILS ON 3 INCH CENTERS, DRIVE TWO 30 PENNY CEMENT-COATED NAILS THROUGH SIDE PANEL INTO EACH 2 X 4 ON TOP PANEL (8 PLACES).

   B. WHEN 5A HAS BEEN COMPLETED SLOPE THE EDGES OF THE EXPOSED FIBERGLASS APPROX. 1 INCH BACK FROM EDGE. USE A #40 SANDING DISC. A ROUGH SURFACE SHOULD REMAIN AFTER SANDING. THEN SPRAY A COAT OF RESIN ON THE AREA THAT IS NOT FIBERGLASSED. FIBERGLASS THIS AREA PER SPA740082. APPLY THE FIBERGLASS SO THAT IT OVERLAPS THE SANDED AREA.

6. WHEN THE PURCHASE ORDER SPECIFIES A NON-FIBERGLASSED BOX, OMIT ASSEMBLY STEPS PER NOTE 3. TEMPORARILY SECURE LID WITH DOUBLE-HEADED NAILS OR OTHER SUITABLE FASTENERS TO RESIST BLOWING OFF IN HIGH WINDS DURING STORAGE OR TRANSPORTATION.

7. REMOVE ALL SPLINTERS & SAND ALL EDGES.

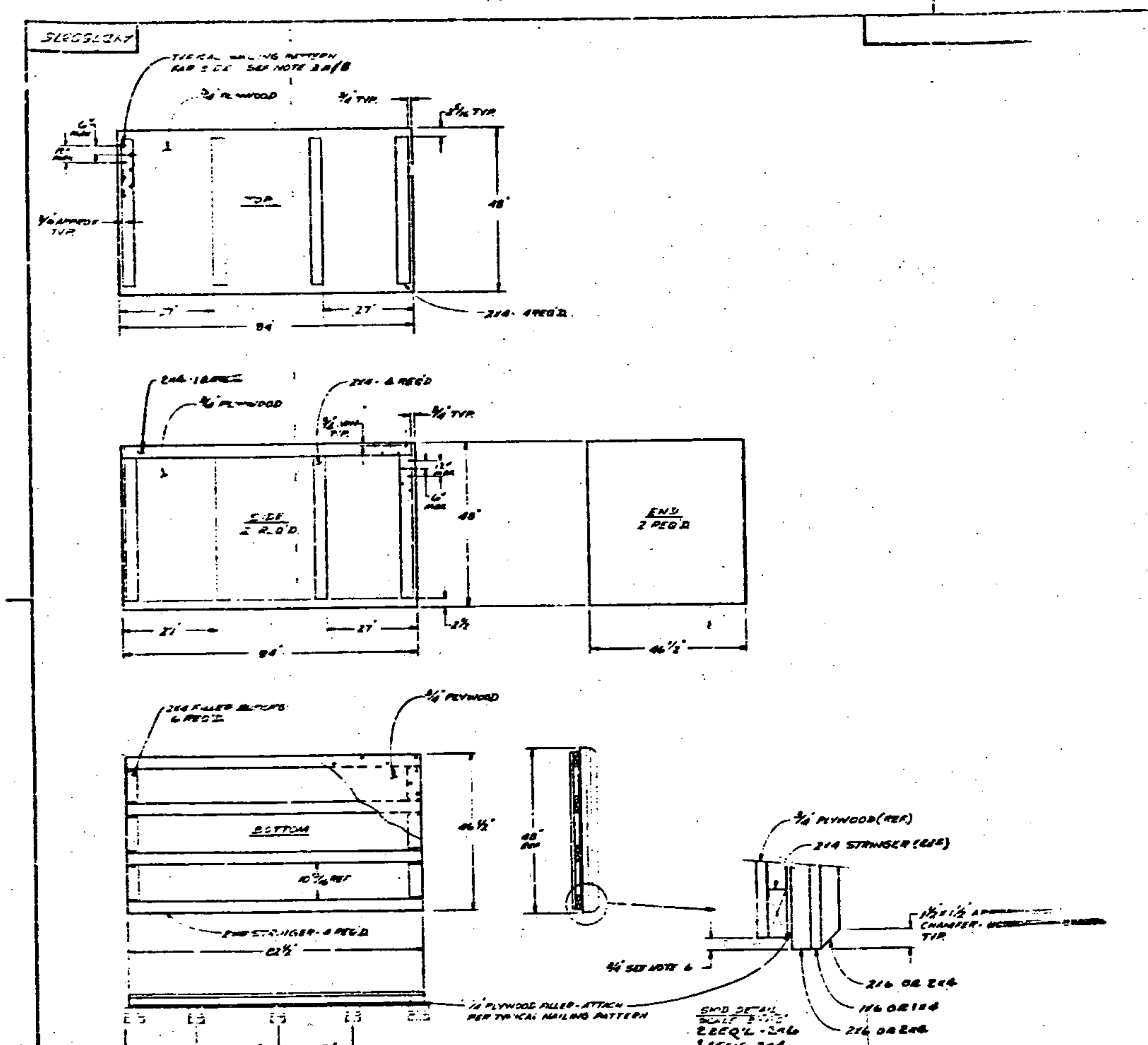
8. AFTER FIBERGLASSING PAINT A 4" WIDE BAND (YELLOW) AROUND ENTIRE BOX, PAINT AS SHOWN.

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN INCHES.
ALL ITEMS TO BE AS SPECIFIED OR APPROVED EQUAL.
FOR EXPLANATION OF DIMENSIONS, TOLERANCES AND SYMBOLS SEE SPA740043 AND SPA740048.
UNLESS OTHERWISE SPECIFIED DIMENSIONAL LIMITS AND SURFACE TEXTURE DESIGNATIONS APPLY AFTER PLATING.
REMOVE ALL BURRS AND SHARP EDGES EXCEPT AS INDICATED.

MONSANTO RESEARCH CORPORATION
MOUND LABORATORY
MIAMISBURG, OHIO

PROGRAM: NUCLEAR SHIPPING CONTAINER
TITLE: TRU WASTE PLYWOOD BOX ASSEMBLY

DWG NO AYD 755375 SHT 1 OF 2



NOTES:

1. MATERIAL:

   A. PLYWOOD - EXTERIOR TYPE UNSANDED. GRADE C-C OR BETTER. 3/4 INCH (GSA #5530-251-1199). EXCEPT BOTTOM FILLER PANEL SHALL BE 1/4 INCH. GRADE AND TYPE PER FABRICATOR'S OPTION.

   B. FRAMING MEMBERS - 2 x 4 S4S CONSTRUCTION GRADE. SEASONED. SELECT TO BE FREE OF BARK AND LOOSE KNOTS.

2. PANEL EDGES SHALL BE STRAIGHT AND SQUARE FOR TIGHT FIT WITH ADJACENT PANELS. FRAMING MEMBERS SHOWN FLUSH SHALL BE FLUSH TO 1/16 INCH MAXIMUM BELOW EDGE.

3. ALL JOINTS SHALL BE GLUED AND NAILED AS FOLLOWS:

   A. APPLY CONTINUOUS PATH OF WHITE WATER-RESISTANT RESIN GLUE. FRANKLIN "EVERTITE" OR FRANKLIN "TITE BOND" OR EQUAL ALONG EACH JOINT. GLUE SHALL COVER AT LEAST 50 PERCENT OF JOINT INTERFACE.

   B. APPLY 6 PENNY CEMENT COATED BOX NAILS OR 2 INCH PLASTIC COATED STAPLES IN PATTERN SHOWN. EXCEPT THERE SHALL BE AT LEAST 3 FASTENERS THROUGH EACH FILLER BLOCK. DRIVE FROM PLYWOOD SIDE WITH HEADS FLUSH TO 1/16-INCH MAXIMUM BELOW SURFACE. STAPLES SHALL CROSS GRAIN OF FIRST PLY AT NOT LESS THAN A 40° ANGLE.

4. THE BUYER'S ACCEPTANCE OF EACH LOT OF PANELS DELIVERED WILL BE BASED ON A VISUAL INSPECTION OF LUMBER GRADE, WORKMANSHIP, AND CONSTRUCTION AND A FUNCTIONAL OR DIMENSIONAL INSPECTION FOR PANEL SIZE.

5. EACH DELIVERY SHALL INCLUDE PARTS REQUIRED FOR A MULTIPLE OF COMPLETE BOXES. PANELS SHALL BE BANDED, HANDLED, AND SHIPPED TO ASSURE DAMAGE FREE DELIVERY. ANY MARKING REQUIRED SHALL BE SPECIFIED IN THE PURCHASE ORDER.

6. FIBERGLASS BOX AND ATTACH SKIDS PER SPA740082, PARA

   A ASSEMBLE SKIDS (2 X 4 AND 2 X 6) USING 12 PENNY CEMENT COATED NAILS IN PATTERN SHOWN

7. ALL DIMENSIONS ARE IN INCHES. TOLERANCE ± 1/16 INCH EXCEPT AS NOTED.

8. REMOVE ALL SPLINTERS & SAND ALL EDGES.

UNLESS OTHERWISE SPECIFIED, ALL DIMENSIONS ARE IN INCHES.

ALL ITEMS TO BE AS SPECIFIED OR APPROVED EQUAL.

FOR EXPLANATION OF DIMENSIONS, TOLERANCES AND SYMBOLS SEE SPA740243 AND ANSI Y14.5.

UNLESS OTHERWISE SPECIFIED DIMENSIONAL LIMITS AND SURFACE TEXTURE DESIGNATIONS APPLY AFTER PLATING.

REMOVE ALL BURRS AND SHARP EDGES EXCEPT AS SPECIFIED.

REV	DATE	REVISION	BY	CHK	APPR
A	9/4/75	ORIGINAL ISSUE			
B					

DWG TYPE:

MONSANTO RESEARCH CORPORATION
MOUND LABORATORY
MIAMISBURG, OHIO

PROGRAMS: NUCLEAR SHIPPING CONTAINER

TITLE: TRU WASTE PLYWOOD BOX DETAILS

DRAWN	DATE 9-5-75	
CHECKED	DATE	
SPONSOR	DATE	
APPROVED	DATE	
SCALE	JOB NO	

CODE IDENT NO 14085

DWG NO AY275275 SHT 2 OF 2

APPENDIX D

CERTIFICATES OF COMPLIANCE FOR OVERPACKS

1. Certificate of Compliance No. 9070 (Model No. N-55; 55-Gallon Drum Overpack)

2. Certificate of Compliance No. 6400 (Model No. 6400, Super Tiger Overpack)

3. Certificate of Compliance No. 6272 (Model No. 6272, Poly Panther Overpack)

NRC FORM 618

U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIALS PACKAGES

1. a CERTIFICATE NUMBER	b. REVISION NUMBER	c. PACKAGE IDENTIFICATION NUMBER	d. PAGE NUMBER	e. TOTAL NUMBER PAGES
9070	10	USA/9070/B( )F	1	3

2. PREAMBLE

a. This certificate is issued to certify that the packaging and contents described in Item 5 below, meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."

b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

a. PREPARED BY (Name and Address):

Nuclear Packaging, Inc.
1010 South 336th Street
Federal Way, WA 98003

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION:

Nuclear Packaging, Incorporated application dated April 23, 1982.

c. DOCKET NUMBER 71-9070

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5.

(a) Packaging

(1) Model No.: N-55

(2) Description

A low carbon steel overpack filled with rigid polyurethane foam. The containment vessel is a 55-gallon drum, meeting the requirements of DOT Specification 17H or 17C. The overpack is a right circular cylinder 48 inches high by 32 inches diameter with a 34-1/2-inch high by 24-inch diameter cavity. The 20-gauge galvanized steel shell is filled with 3-pound per cubic foot rigid polyurethane foam. Closure of the upper and lower (lid and body) sections of the overpack is provided by four toggle clamps, and a Neoprene gasket at the stepped joint between the two sections. Four lugs are provided for lifting and tie-down. The package gross weight is approximately 750 pounds.

(3) Drawing

The packaging is constructed in accordance with Nuclear Packaging, Incorporated Drawing No. X-60-200D, Rev. C.

(b) Contents

(1) Type and form of material

(i) Radioactive material including fissile material in the form of dry solids contained in DOT Specification 17H or 17C steel drums. Liquids, powders and slurries are not permitted.

(ii) Tritium absorbed on metal backing as titanium tritide held within the container assembly shown in Lawrence Livermore Laboratory Drawing No. AAA-77-109723, Rev. C.

(iii) Dry, solid forms of plutonium and uranium.

(2) Maximum quantity of material per package

(i) For the contents described in 5(b)(1)(i) greater than Type A quantity radioactive material. Fissile material contents not to exceed the generally licensed mass limits as specified in 10 CFR §§71.18 and 71.22 and plutonium in excess of twenty (20) curies per package must be in the form of metal, metal alloy or reactor fuel elements. Internal decay heat not to exceed 3 watts.

(ii) For the contents described in 5(b)(1)(ii) a maximum of six (6) container assemblies held within a DOT Specification 17H steel drum. Maximum activity not to exceed 30,000 curies per package. Internal decay heat not to exceed 1.08 watts per package.

(iii) For the contents described in 5(b)(1)(iii), 200 grams plutonium plus fissile uranium provided the total plutonium content does not exceed 200 grams, with a heat generation rate of 5 watts. The radioactive material must be packaged within sealed metal cans or DOT Specification 2R containers and placed within inner containers constructed as specified in Appendix 1.10.4.1, 1.10.4.2, and 1.10.4.3 of the application. Prior to each shipment, a helium leak test must be performed on both the inner and outer containment assemblies capable of detecting a leak no greater than 10^{-7} atm cc/sec at standard temperature and pressure. Following the gas leak testing, all inner container welds must be leak tested using a liquid penetrant method in accordance with Article 6, Section V, ASME Code. No package with a detectable leak shall be delivered to a carrier for transport.

(3) Fissile Class II

Minimum transport index to be shown on label: For the contents described in 5(b)(1)(iii): Five (5)

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6. The maximum weight of contents including drum not to exceed 550 pounds.

7. The drum must be securely positioned in the overpack.

8. Contents must be securely positioned so that protrusions will not puncture the drum under normal or accident conditions.

9. The packaging authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.12.

10. Expiration date: May 31, 1987.

REFERENCE

Nuclear Packaging, Incorporated Safety Analysis Report dated April 23, 1982.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

R H Odegaarden

for Charles E. MacDonald, Chief
Transportation Certification Branch
Division of Fuel Cycle and
Material Safety, NMSS

Date: DEC 1 1983

NRC FORM 618
(6-83)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIALS PACKAGES

1. a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. PACKAGE IDENTIFICATION NUMBER	d. PAGE NUMBER	e. TOTAL NUMBER PAGES
6400	14	USA/6400/B( )F	1	7

2. PREAMBLE

a. This certificate is issued to certify that the packaging and contents described in Item 5 below, meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."

b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

a. PREPARED BY (Name and Address):

Westinghouse Electric Corporation
P.O. Box 355
Pittsburgh, PA 15230

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION:

Westinghouse Electric Corporation application dated August 7, 1981, as supplemented.

c. DOCKET NUMBER 71-6400

4. CONDITIONS

This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5. (a) Packaging

(1) Model No.: 6400

(2) Description

A protective overpack which provides impact and thermal protection for its contents. The inner shell (cavity) is approximately 76" x 76" x 172" constructed of 3/16" thick and 10-gauge mild steel. Closure of the cavity is by a 1/4" thick aluminum plate with silicone rubber gasket which is bolted to the main inner shell. The cavity is centered and supported in an outer 3/16" thick steel jacket by approximately 32" of polyurethane foam insulation at the end and 10" on the sides. A removable section or cap consisting of approximately 34" of polyurethane foam insulation encased in steel with a silicone rubber gasket is bolted to the main outer steel jacket. The overall dimensions of the package are approximately 8' x 8' x 20'. Vent holes are provided on the sides and ends of the container. Set into each corner of the outer container are standard I.S.O. steel castings. The total weight including weight of the contents is 45,000 pounds.

(3) Drawings

Packaging is constructed in accordance with one of the following sets of drawings: (1) Protective Packaging, Inc, Drawing Nos. 32106, Sheet 1, Rev. F and 32106, Sheet 2, Rev. 0; or (2) Westinghouse Electric Corporation Drawing No. 2020D08, Sheet 1 and 2, Rev. 0; or (3) Babcock and Wilcox Company Drawing No. 11-D-2130, Rev. 0; or (4) Protective Packaging, Inc., Drawing Nos. 32106-1, Sheet 1, Rev. F and 32106, Sheet 2, Rev. 0, as modified by Nuclear Packaging Inc. Drawing No. EG-60-01D, Sheets 1 and 2, Rev. 0; or (5) Protective Packaging, Inc. Drawing No. 32395, Sheets 1 through 9, Rev. B, as modified by Sandia Laboratories letter dated May 8, 1980; or (6) Lawrence Livermore National Laboratory Drawing Nos. AAA81-108683-00, Rev. 0 and AAA81-110194-00, Rev. 0.

(b) Contents

(1) Large, decontaminated equipment waste of such size as not to fit into a 55-gallon drum (with legs or other readily removable appendages removed). Not to exceed 200 grams plutonium within the package.

Equipment waste surfaces containing more than 0.5 Ci must be decontaminated to a smearable level of no more than 150,000 dpm/100 cm^2 prior to fixation or until successive decontamination cleaning operations do not reduce the smearable contamination levels by more than ten percent. After fixation, equipment waste surfaces must have a smearable level of contamination of no greater than 10,000 dpm/100 cm^2. Outer surfaces must have a smearable level of contamination of no greater than 20 dpm/100 cm^2. Prior to fixing of contamination, large equipment waste must be inspected to insure that: (a) all sharp or protruding objects have been removed, blunted or protected with packaging material, and (b) pipe caps, gasketed blind flanges, covers, etc., have been installed wherever possible. Following such inspection, the inner surfaces containing more than 0.5 ci must be fixed with "strip" or "clear" coating. The inner surface(s) may alternatively be fixed with a polyurethane foam.

The large equipment waste must be enclosed in a tight-fitting, 1-inch thick plywood box constructed in accordance with Westinghouse Electric Corporation's Drawing No. 1620E43, Sheets 1, 2, 3, and 4, Rev. 3; a tight fitting 3/16" thick corrugated steel box constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91888, Sheet 1, Rev. 0 (modified or unmodified); or enclosed in a tight fitting box constructed in accordance with General Electric Company Drawing Nos. 908E614, Rev. 1, and 908E619, Rev. 2 or 908E648, Rev. 0 or 908E649, Rev. 0; or enclosed in a tight fitting box constructed in accordance with Babcock and Wilcox Company Drawing No. LRC-70019 H, Rev. 2. The space between the equipment and the box must be filled with foam (1" minimum foam thickness) and between equipment (1/2" minimum foam thickness).

Alternatively, gloveboxes contaminated and fixed as described above may be broken down as follows:

Glovebox windows are removed and separately packaged in 12-mil thick PVC bags and sealed. The inner bag is tape sealed and the outer bag is heat sealed.

Glovebox panels are cut to dimensions to fit inside the 3/16" thick corrugated steel burial crates constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91833, Sheet 1, Rev. 0 (modified or unmodified). All sharp or protruding objects are removed, blunted, or protected with packaging material. The glovebox panels are bundled such that internal box surfaces are facing inward. Cut glovebox panels from not more than one glovebox are banded with metal strap banding such that two metal strap bands in each direction are placed around the length and width of the glovebox sections. The glovebox window and cut panel packages are enclosed and foamed in place within the box.

Blocking or dunnage is placed within the box to ensure a one inch foam barrier on the sides and bottom of the box. Likewise, dunnage is provided between the banded glovebox sections to maintain a 1/2" thick foam barrier between banded packages.

(2) Decontaminated hard waste items, such as equipment, metal cans, tools, etc., must be double bagged within 12-mil thick PVC with each bag heat sealed. The total fissile quantity of all the sealed packages in one container must not exceed 200 grams.

Hard waste surfaces must be decontaminated to a smearable level of no more than 150,000 dpm/100 cm^2 prior to fixation or until successive decontamination cleaning operations do not reduce the smearable contamination levels by more than 10 percent. After fixation, hard waste surfaces must have a smearable level of contamination of no greater than 10,000 dpm/100 cm^2. Prior to fixing of contamination, hard waste must be inspected to insure that sharp or protruding objects have been removed, blunted, or protected with packaging material. Following such inspection, the outer surfaces must be fixed with "strip" or "clear" coating. Hard waste items such as furnace shells, muffles, or other items with large cavities not accessible for decontamination must be filled with foam within the cavities. Surfaces that are not easily accessible, e.g., interiors of small diameter tubing and piping which were in contact with process materials, must have been swabbed or immersed in cleaning solution to insure removal of residual material. Open ends of the tubing and piping must be sealed using mechanical fittings.

Alternately, large heavy walled process glassware must be painted inside and outside to fix contamination and double bagged in 12-mil thick PVC with each bag heat sealed. The glassware must be secured in a box constructed in accordance with General Electric Company Drawing No. 272E81-4, Rev. 0. The box must be filled with foam and total activity limited to less than two (2) ci in a box.

Alternately, stainless steel transfer tubes and HEPA filters must be double bagged in 12-mil thick PVC with each bag heat sealed. The tubes/filters must be secured in a box constructed in accordance with General Electric Company Drawing No. 272E81-28, Rev. 0. The box must be filled with foam and total activity limited to less than 0.5 Ci in a box.

Alternately, round steel ducting must be capped and secured in a box constructed in accordance with General Electric Company Drawing No. 272E81-29, Rev. 0; 272E81-30, Rev. 0; or 272E81-31, Rev. 0. Outer surfaces ducting will have a smearable level of contamination no greater than 20 d/m/100 cm^2. The box must be filled with foam and total activity limited to less than 0.5 ci in a box.

Sealed packages and boxes of hard waste must be enclosed in a tight-fitting, 1-inch thick plywood box constructed in accordance with Westinghouse Electric Corporation's Drawing No. 1620E43, Sheets 1, 2, 3, and 4, Rev. 3; a tight-fitting 3/16" thick corrugated steel box constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91388, Sheet 1, Rev. 0 (modified or unmodified); enclosed in a tight fitting box constructed in accordance with General Electric Company Drawing Nos. 908E614, Rev. 1 and 908E619, Rev. 2 or 908E648, Rev. 0 or 908E649, Rev. 0; or enclosed in a tight fitting box constructed in accordance with Babcock and Wilcox Company Drawing No. LRC-70019 H, Rev. 2. The space between the packages and the box must be filled with foam to a minimum thickness of 1 inch. Void spaces between the sealed packages must be filled with foam (1/2" minimum foam thickness).

(3) Glove box absolute (HEPA) filters must be double bagged within 12-mil thick PVC, with each bag heat sealed and packaged within DOT Specification 17H or 17C steel drums (maximum size of 55 gallons). Each drum must be lined with a sealed plastic liner and equipped with a standard drum closure. Each drum must not exceed a fissile quantity of 60 grams.

Sealed drums must be enclosed in a tight-fitting 1-inch thick plywood box constructed in accordance with Westinghouse Electric Corporation's Drawing No. 1620E43, Sheets 1, 2, 3, and 4, Rev. 3; a tight-fitting 3/16" thick corrugated steel box constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91388, Sheet 1, Rev. 0 (modified or unmodified); enclosed in a tight fitting box constructed in accordance with General Electric Company Drawing Nos. 908E614, Rev. 1 and 908E619, Rev. 2, or 908E648, Rev. 0, or 908E649, Rev 0; or enclosed in a tight fitting box constructed in accordance with Babcock and Wilcox Company Drawing No. LRC-70019 H, Rev. 2. The space between the drums and the box must be filled with foam to a minimum thickness of 1 inch. Void spaces between drums must be filled with foam (1/2" minimum foam thickness).

(4) Soft waste items such as sheeting, gloves, paper, prefilter media, polyethylene bottles, shoe covers, etc., must be double bagged in 12-mil thick PVC, with each bag heat sealed (bag size must not exceed 22" x 16" x 10") and packaged within DOT Specification 17H or 17C steel drums (maximum size of 55 gallons). Each drum must be lined with a sealed plastic liner and equipped with a standard drum closure. Each drum must not exceed a fissile quantity of 60 grams.

Sealed drums must be enclosed in a tight-fitting 1-inch thick plywood box constructed in accordance with Westinghouse Electric Corporation's Drawing No. 1620E43, Sheets 1, 2, 3, and 4, Rev. 3; a tight-fitting 3/16" thick corrugated steel box constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91888, Sheet 1, Rev. 0 (modified or unmodified); or enclosed in a tight fitting box constructed in accordance with Babcock and Wilcox Company Drawing No. LRC-70019 H, Rev. 2. The space between the drums and the box must be filled with foam to a minimum thickness of 1 inch. Void spaces between drums must be filled with foam (1/2" minimum foam thickness).

(5) Liquid waste (decontamination solutions only) must be solidified in concrete in a 30-gallon drum which must be sealed in a plastic bag and centered and supported in a DOT Specification 17H or 17C 55-gallon steel drum by absorbent material. The 55-gallon drum must be lined with a sealed plastic liner and equipped with a standard drum closure. Each drum must not exceed a fissile quantity of 60 grams.

Alternatively, liquid waste is solidified in concrete in maximum size one (1) gallon packages which are double bagged and heat sealed in 12-mil thick PVC and placed with a DOT Specification 17H or 17C steel drum (maximum size of 55 gallons). The drum is lined with a sealed plastic liner and equipped with a standard drum closure. Each 55-gallon drum must not exceed a fissile quantity of 60 grams. For drums smaller than 55-gallons, the total fissile quantity of all the sealed packages (drums) in one container must not exceed 200 grams.

Sealed drums must be enclosed in a tight-fitting 1-inch thick plywood box constructed in accordance with Westinghouse Electric Corporation's Drawing No. 1620E43, Sheets 1, 2, 3, and 4, Rev. 3; or a tight-fitting 3/16" thick corrugated steel box constructed in accordance with Rockwell Hanford Operations' Drawing No. H-2-91838, Sheet 1, Rev. 0 (modified or unmodified); enclosed in a tight-fitting box constructed in accordance with General Electric Company Drawing Nos. 908E614, Rev. 1 and 908E619, Rev. 2 or 908E648, Rev. 0 or 908E649, Rev. 0; or enclosed in a tight fitting box constructed in accordance with Babcock and Wilcox Company Drawing No. LRC-70019 H, Rev. 2. The space between the drums and the box must be filled with foam to a minimum thickness of 1 inch. Void spaces between drums must be filled with foam (1/2" minimum foam thickness).

(6) Uranium 233 oxide and thorium oxide in the form of intact LWBR-type fuel rods with the following limitations:

(i) Rods shall be packaged within the Model No. 6400 packaging as described in Section 1 of WAPD-LP(FE)-220, Rev. 3 (February 1983);

(ii) The fuel content shall not exceed 50 kg U-233 per shipment;

(iii) All rod storage containers shall be filled to capacity (at least 70% of cross-sectional area) with rods or aluminum shim stock;

(iv) Each rod storage container shall contain not more than one sub-container of 5/9 or 12 w/o BMU seed rods;

(v) Each rod storage container shall weigh not more than 2,000 pounds;

(vi) The fuel rod heat generation shall not exceed 30 watts; and

(vii) Operating Procedures and Acceptance Tests and Maintenance Program shall be modified to meet the requirement of Item 11 of this approval.

(7) Liquid analytical residues from the dissolution of spent reactor fuel rods, solidified in cement (see table, p. 3 of application*). The cement is contained in 1.5-gal steel can closed with a slip cover lid. The two primary cans are packed in a secondary steel can sealed with a press fit lid (see Figure 2 of application*). The secondary containment package contents are placed within a radiation shield (lid secured with six (6), 1/2"-13UNC bolts with welds in accordance with application*) centered in a DOT Specification 17-C 55-gal steel drum (see Figure 1 of application*). The drums are sealed with styrene-butadiene rubber gasket contained with a standard drum closer. Total weight of the drum will be less than 1,450 lb, and each drum will not exceed a fissile quantity of 12 g and 435 ci of fission products.

Six (6) 55-gal sealed drum assemblies will be enclosed in a tight-fitting 3/16-in thick corrugated steel box constructed in accordance with Rockwell-Hanford Operations' Drawing No. H-2-91888, Sheet 1, Rev. 0 (modified or unmodified).. The space between the drums and the box must be filled with foam to a minimum thickness of 1 inch. Void spaces between drums must be fitted with foam to a minimum thickness of 1/2 inch. Two (2) corrugated steel box assemblies may be transported in the packaging.

* U.S. Department of Energy letter dated April 15, 1983.

(c) Fissile Class III

Maximum number of packages per shipment One (1)

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6. The polyurethane foam must be Instapak 200, or equivalent.

7. The maximum weight of the contents including secondary packaging, dunnage, shoring and bracing must not exceed 30,000 pounds.

8. Sufficient dunnage, shoring and/or bracing must be utilized to minimize secondary impact of the secondary packaging within the cavity under accident conditions.

9. Protrusions from secondary packaging such as lifting eyes, etc., must be positioned such that they will not contact the cavity walls, or shoring must be provided to prevent puncture of the cavity walls by the protrusions under the accident conditions.

10. Contents must be positioned in the cavity such that the center of gravity of the loaded package is substantially the same as the center of gravity of an empty package.

11. The cavity of the overpack must be vented through an absolute filter to equalize pressure between the outside and inside of the overpack.

12. Package Model No. 6400 is exempt from the requirements of 10 CFR §71.42 only for the purpose of making these shipments.

13. The package authorized by this certificate is hereby approved for use under the general license provisions of 10 CFR §71.12.

14. Expiration date: November 30, 1986.

REFERENCES

Westinghouse Electric Corporation application dated August 7, 1981.

General Electric Company supplement dated: October 1, 1981.

Babcock and Wilcox Company supplement dated: March 8, 1982.

U.S. Department of Energy, Division of Naval Reactors, supplement dated: April 22, 1983.

U.S. Department of Energy, Chicago Operations Office, supplement dated: April 15, 1983.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Charles E. MacDonald

Charles E. MacDonald, Chief
Transportation Certification Branch
Division of Fuel Cycle and
Material Safety, NMSS

Date: JUL 14 1983

NRC FORM 618
(6-83)
10 CFR 71

U.S. NUCLEAR REGULATORY COMMISSION

CERTIFICATE OF COMPLIANCE
FOR RADIOACTIVE MATERIALS PACKAGES

1.a. CERTIFICATE NUMBER	b. REVISION NUMBER	c. PACKAGE IDENTIFICATION NUMBER	d. PAGE NUMBER	e. TOTAL NUMBER PAGES
6272	4	USA/6272/B( )	1	3

2. PREAMBLE
   a. This certificate is issued to certify that the packaging and contents described in Item 5 below, meets the applicable safety standards set forth in Title 10, Code of Federal Regulations, Part 71, "Packaging of Radioactive Materials for Transport and Transportation of Radioactive Material Under Certain Conditions."
   b. This certificate does not relieve the consignor from compliance with any requirement of the regulations of the U.S. Department of Transportation or other applicable regulatory agencies, including the government of any country through or into which the package will be transported.

3. THIS CERTIFICATE IS ISSUED ON THE BASIS OF A SAFETY ANALYSIS REPORT OF THE PACKAGE DESIGN OR APPLICATION

a. PREPARED BY (Name and Address):

U.S. Ecology
P.O. Box 7246
Louisville, KY 40207

b. TITLE AND IDENTIFICATION OF REPORT OR APPLICATION:

Protective Packaging, Inc. application dated June 24, 1974, as supplemented

c. DOCKET NUMBER 71-6272

4. CONDITIONS
This certificate is conditional upon fulfilling the requirements of 10 CFR Part 71, as applicable, and the conditions specified below.

5.

(a) Packaging:

(1) Model No.: 6272

(2) Description

A protective overpack having a double-walled, low-carbon steel shell (3/16" outer wall and 20 gauge inside wall) with rigid polyurethane foam (nominally 7" thick) thermal-shock insulation between the walls. The edges of the overpack are reinforced with 10 gauge steel angles welded to the outer face of the walls and internal diagonal 14 guage steel plates. Overpack lid closure is provided by three, 1" steel rods which extend the full width, welded to an end plate at one end and secured by a pin at the other end. Enclosed within the overpack is a bolted and gasketed, 12 gauge low carbon steel inner container. The gross weight of the package is about 6,100 pounds.

(3) Drawings

The overpack is constructed in accordance with Mechanics Research, Inc., Drawing No. 121947, revised to May 21, 1970. The waste M-3 steel bin (inner container) is constructed in accordance with Argonne National Laboratory's Drawing No. CS-2273.

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5. (b) Contents

(1) Type and form of material

(i) Dry, solid radioactive material within the waste storage bin; or

(ii) Liquid analytical residues from the dissolution of spent reactor fuel rods, solidified in cement (see table, p. 3 of application*). The cement is contained in 1.5-gal steel can closed with a slip cover lid. The two primary cans are packed in a secondary steel can sealed with a press fit lid (see Figure 2 of application*). The secondary containment package contents are placed within a radiation shield (lid secured with six (6), 1/2"-13UNC bolts with welds in accordance with application*) centered in a DOT Specification 17-C 55-gal steel drum (see Figure 1 of application*). The drum is sealed with styrene-butadiene rubber gasket contained with a standard drum closer and loaded into a M-3 steel bin with polyurethane foam dunnage material (Instapack 200, or equivalent).

* U.S. Department of Energy letter dated April 15, 1983.

(2) Maximum quantity of material per package

The maximum weight of the contents (including dunnage) shall not exceed 3,000 pounds, and:

For the contents specified in 5(b)(1)(i):

The thermal heat load shall not exceed 5 watts; or

For the contents specified in 5(b)(1)(ii):

The package is limited to 435 ci of mixed fission products and 12 g fissile material.

6. Contents within the inner container must be either packed full or must be securely braced to prevent movement.

7. The cover of the inner container must be secured by at least 20 bolts (5 per side) of not less than 5/16-inch diameter.

8. Prior to each shipment the inner container lid gasket shall be inspected. The gasket shall be replaced if inspection shows any defects or every twelve (12) months, whichever occurs first.

9. The package authorized by this cerificate is hereby approved for use under the general license provisions of 10 CFR §71.12.

10. Expiration date: March 31, 1985.

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REFERENCES

Protective Packaging, Inc. application dated June 24, 1974.

Supplement dated: January 28, 1975.

U.S. Department of Energy, Chicago Operations Office, supplement dated: April 15, 1983.

FOR THE U.S. NUCLEAR REGULATORY COMMISSION

Charles E. MacDonald
Charles E. MacDonald, Chief
Transportation Certification Branch
Division of Fuel Cycle and
Material Safety

Date: JUL 15 1983

UNITED STATES NUCLEAR REGULATORY COMMISSION

APPENDIX E

TRAINING PROGRAM ON USE OF FULL-FACE RESPIRATORS

TRAINING PROGRAM

HEALTH AND SAFETY INSTRUCTIONS ON USE OF FULL-FACE RESPIRATORS

FOR

THE DECOMMISSIONING AND DECONTAMINATION

OF

THE PLUTONIUM FUELS DEVELOPMENT LABORATORY

CHESWICK, PENNSYLVANIA

H. C. Woodsum 5/18/82

BY: H. C. Woodsum, Supervisor
Industrial Hygiene

May 13, 1982

1.0 PURPOSE

The purpose of these instructions is to provide the basis for selection and instruction on proper use and care of respiratory protection equipment. Items covered will include: Introduction, proper use of respirators, consequence of improper use of respirators, and testing of the effectiveness of respirators.

2.0 INTRODUCTION

The objective of respiratory protection is to limit the potential inhalation of airborne radioactive materials to concentrations "as low as reasonably achievable" (ALARA) below those specified in Appendix B, Table I, Column I of 10 CFR, Part 20. For routine operations, this is accomplished by application of engineered controls in process and ventilation equipment, containment cleanliness, and preplanned work. Nevertheless, the use of respiratory protective devices for PFDL sectioning operations is appropriate. Controls that have been applied with success in limiting the concentrations of airborne radioactive materials in the sectioning operations are:

1. Removal of any extraneous parts or materials while glove boxes are still on process line prior to sectioning.

2. Decontaminating and fixing of interior glove box surfaces to levels less than 150,000 dpm/100 cm^2 and less than 10,000 dpm/100 cm^2 of fixed and removable contamination, respectively.

3. Exclusive use of the general Analytical Laboratory for sectioning operations.

4. Containment of sectioning and packaging operations by constructing plastic tenting in modules for (a) cutting operations, (b) packaging operations, and (c) health physics monitoring of personnel and materials.

5. Use of an effective air exhaust which provides a high removal of airborne contamination in the sectioning work areas (greater than one air change per minute occurs in the sectioning module).

6. No direct removal of glove box window gaskets.

7. Use of latex putty around window gaskets and other inaccessible areas of glove boxes to reduce airborne contamination when cutting through a gasket.

8. Local ventilation in the form of a four-inch diameter flexible hose connected to a doubly HEPA filtered exhaust system to remove any airborne radioactive materials generated in cutting operations.

9. Use of water spray to reduce airborne particulates during cutting operations.

10. When necessary, the immediate decontamination of sectioning module floor and fixing using a fast drying lacquer to reduce spread of contamination.

Within the framework of regulations and restrictions, we are permitted to select and supply respiratory protective equipment which will provide a protection factor greater than the multiple by which peak concentrations of radioactive materials are expected to exceed the maximum permissible concentration (MPC).

In evaluating the need for respiratory equipment for sectioning operations, consideration of the hazards and previous experience at other plutonium laboratories indicated that airborne levels could potentially reach 100 times MPC even if all other available engineering safeguards previously listed were used. Consequently, a full-face, negative-pressure, air-purifying respirator cannot be used on the basis that its protection factor of 50 will not limit potential exposure to concentrations below permissible levels. A protection factor of 2,000 is afforded by a full-face, continuous-flow, supplied-air system as approved by Mine Safety and Health Administration (MSHA) and the National Institute for Occupational Safety and Health (NIOSH). This system was adopted for use in the sectioning area.

Nuclear Regulatory Commission (NRC) approval of respiratory protection equipment is based on Title 30, Code of Federal Regulations, Part 11 (30 CFR 11) and as detailed in the Industrial Hygiene Procedure CS-IH-0703. Federal regulatory approval is currently determined by the Bureau of Mines Testing and Certification Laboratory of NIOSH at Morgantown, West Virginia, as stipulated in NRC Regulations 10 CFR 20.

At the Plutonium Fuels Development Laboratory (PFDL), we have elected to use the most stringent MPC in air (MPC_a) which is for transportable (soluble in body fluids) forms of plutonium. Its value corresponds to 2×10^{-12} μCi/cc or 4.4 dpm per m^3 of alpha activity. Whether the plutonium is transportable or non-transportable depends on a combination of physical, chemical, and biological factors which may not be known with a high degree of accuracy. Therefore, the conservative approach of using the lowest MPC has been followed. This value strictly applies for a highly transportable form such as plutonium-nitrate. The majority of airborne contamination at PFDL is most likely due to airborne mixed oxide (UO_2-PuO_2) fuel and is generally considered non-transportable. Thus an inherent safety factor of up to 20 should result from using the selected MPC_a noted previously.

Regardless of chemical form, smaller particle sizes (e.g., <1 µm mass median aerodynamic diameter) will behave more transportable in body fluids than the larger particle sizes. The particle size distribution in sectioning operations is not well known at the present time, but steps are being made to measure this distribution by use of a cascade impactor. Such information will help establish what margin of safety exists based on the conservative MPC_a which has been adopted.

Proper use of respiratory protection is imperative. If properly worn, the respiratory protection system will afford the protection expected; if improperly worn or improperly cared for, the respiratory protection system may not adequately do its job.

This is also true of the air-purifying, negative-pressure respirator which is adequate for most jobs at PFDL (other than sectioning) where respiratory protection factors of 50 or less are required.

3.0 PROPER USE OF RESPIRATOR

3.1 How to Put on a Respirator

The following steps describe how to put on a full-face respirator:

1. With clean hands, remove the respirator from its plastic bag.

   NOTE: Do not handle the respirator with contaminated gloves since this contamination could be transferred to the respirator.

2. Make sure all the head harness straps are as loose as possible.

3. Grasp lower straps and insert the chin.

4. Pull the straps up and over your head.

5. Adjust the mask to your face.

6. Tighten straps, two at a time (one on each side), starting with the bottom strap and working up.

7. Qualitatively check the fit of the respirator prior to each use by covering the inhalation openings on the filter cartridge. On the newest type filter cartridge (rectangular with ultra-filters which have an initial efficiency of 99.98% against >0.3 μm particles), these openings are located as narrow slits on the outside end surfaces. Then breathe in and hold your breathe and see if the mask pulls against the face and stays that way for a minimum of 10 seconds. If so, the mask fits properly and may be used in a toxic atmosphere provided that a quantitative fit test has been completed successfully within the proper required time interval.

> NOTE: A qualitative fit test is necessary before each entry into a toxic atmosphere.

For a respirator with duo-flo breathing apparatus and when suited with double coveralls as required for sectioning operations, assistance will most likely be required and will be provided to conduct the qualitative fit test since it will be awkward if not impossible to cover the inhalation ports. Such assistance will be rendered by a fellow worker or a health physics technician.

3.2 How to Remove, Check for Contamination, and Store the Respirator

For the sectioning complex area, a specific procedure is required as follows:

1. Your face mask must be checked with an alpha meter on the way out of the sectioning area (i.e., you must be monitored or monitor yourself at the entrance-exit to the sectioning room area). If the mask is contaminated, the exterior of the mask should be wiped clean and Health Physics should be notified.

2. Once the mask is monitored and cleaned, you should leave the contaminated area, remove the mask, clean it thoroughly, and hang it on a hook in the spectrographic lab where the sectioning area monitoring post is located.

3. A health physics technician will smear the mask and attached hose. If the mask and hose are found non-contaminated, the health physics technician will place the mask in a plastic bag and then into the locker in the spectrographic lab.

If the mask and/or hose are contaminated, the health physics technician will notify you. It is your responsibility to clean it. After cleaning, it will be smeared by the health physics technician. This process should be repeated until the mask is determined to be clean. If the mask cannot be cleaned prior to the time you have to leave for the day, it will be tagged "HOLD - DO NOT USE" and will be placed on the holding hooks in the spectrographic lab. On the following day, the mask must be cleaned and cleared by Health Physics prior to use.

For respirators in use other than in the sectioning area, a similar procedure is required as follows:

1. After use in a contaminated atmosphere, the face mask should be checked for contamination with an alpha survey meter. If the mask is contaminated, the exterior of the mask should be wiped clean and Health Physics should be notified.

2. Once the mask has been cleared by Health Physics, the mask should be placed in a plastic bag and stored in your assigned locker located in the hallway outside the Health Physics office or other appropriate location.

3.3 How to Inspect the Respirator

The personally-assigned respirators should be inspected before and after each use by the wearer to assure that it is in satisfactory condition. This inspection should include a check for tightness of connections and condition of the facepiece, straps, valves, connecting tube, and canister. Special attention should be given to rubber or elastomer parts to ensure that they are pliable and flexible and not deteriorating or taking a set during storage. You should look for holes, cracks, nicks, and defects.

Respiratory protective devices should never be worn when a satisfactory face seal cannot be obtained. Thus, not only should the mask be inspected prior to each use, but a qualitative fit test also is required. There are many conditions which may prevent a satisfactory face seal. These include excessively long sideburns, a beard, temples on glasses, or an unusually structured face as well as defects in the facepiece and aging of the rubber. Also, the absence of one or both dentures can seriously affect the fit of the facepiece.

If the wearer must wear glasses, prescription lenses will be made available, and these will be installed on a special fixture fastened inside the mask. Such special safety glasses should be adjusted so as not to interfere with the face seal but still permit clear vision for the wearer.

If you note any of the defects described above or have difficulties with your mask or glasses, contact a health physics technician and/or the Industrial Hygiene supervisor for assistance.

In addition to the above inspections which should be performed by the wearer routinely when the respirator is in use, a qualified health physics technician will perform a complete inspection on each respirator—monthly for those involved in sectioning operations and annually for those respirators used in other areas. The results of these inspections are recorded according to Procedure CS-IH-0708 and 0701, respectively. Also, all emergency equipment (self-contained breathing apparatus) is inspected monthly and after each use. A detailed description of the respirator inspection process is given in Industrial Hygiene Procedure CS-IH-0705.

3.4 Testing of Respirators

Fitting and testing of respirators will be carried out under the guidelines of Industrial Hygiene Procedure CS-IH-0701 by the designated health physics technician. Selected personnel will be notified by the designated health physics technician as to time and place for fitting and testing.

The frequency of quantitative testing will be monthly for planned use in the sectioning complex area and annually for all other respirator use. Qualitative tests will be performed immediately prior to each use.

3.5 Cleaning of Respirators

Respiratory protection devices should be cleaned and sanitized after each use. Each individual is responsible for this function. In addition, those respirators which are used frequently in sectioning operations will be thoroughly cleaned monthly by the health physics technician assigned to this task by the Supervisor of Industrial Hygiene. Respirators used infrequently will be thoroughly cleaned annually. Such cleaning will involve the disassembly of the speaker assembly, removal of filter cartridges, etc., then washing and sanitizing the respirator and speaker assembly followed by clean rinse and air dry.

> NOTE: The wearer should not under any circumstances try to disassemble and/or clean the respirator in this fashion since this could jeopardize the proper function of the respirator.

The type of interim or daily cleaning which should be used is described as follows:

1. Use cleaning stations located in various areas where antifogging, sanitizing sprays, and cleaning tissues are evident. Spray disinfectant mist on interior surfaces, especially face seal areas (keep spray off lens where applicable as marked on container).

2. Use clean tissues and wipe areas dry.

3. Spray antifogging mist onto the interior lens surface.

4. Wipe dry using cleaning tissues. Antifogging should be repeated twice for best results.

5. Alternatively, in Step 1, a special cleaning solution may be obtained from the responsible health physics technician to clean and decontaminate the mask surfaces. Use of decon solutions (such as Nutec) is not recommended for use on respirators since this can cause skin irritation.

4.0 IMPROPER USE OF RESPIRATORS

As noted previously, it is imperative that respiratory equipment be worn properly. This simply means that for the equipment to function as it was intended, the rules regarding its care, inspection, cleaning, wearing, testing, and storing must be followed. For example:

1. If the respirator is not inspected at frequent intervals, a defect could develop such that the integrity of the mask is breached.

2. If the mask is not cleaned properly, there is chance for inhaling or ingesting radioactive or toxic material.

3. If the respiratory protection equipment is not worn properly, the effectiveness of the mask could be decreased or nullified.

4. If the mask fit and/or effectiveness is not tested properly, the efficiency could be decreased without the knowledge of such a defect.

5. If the mask is not stored properly, it could become unknowingly contaminated, the face seal could become deformed and leaky, or some damage to the filter or breathing system could result.

Besides individual system malfunctions which should be detected by the qualitative fit test and the frequent visual inspections, certain air supply system malfunctions to the supplied-air system could occur. For example:

1. The supplied-air pressure could drop below the minimum of 35 psi. If this occurred, an alarm would sound in the spectrographic lab and all would exit in an orderly fashion as instructed by Procedure PFDL-OP-D-0853. A minimum protection factor of 50 is provided in this case through the use of the purifying absolute filter cartridge. Thus, no significant exposure should result.

2. High carbon monoxide (CO) could result if the backup oil-lubricated compressor system were used and a malfunction occurred in the adsorbent filter bed. If this occurred, a high CO alarm would result and all persons would exit the sectioning area in an orderly fashion. Other precautions which have been taken to prevent this from happening include moving of the air inlet for breathing air compressors from the mechanical equipment room (where a malfunction in a gas heater is possible) to the hallway and the recharging of the Del Monox Purifier for the oil-lubricated compressor to assure that it is as effective as possible. Furthermore, air grab samples have been taken and analyzed for CO impurity to assure that clean, breathable air is provided. In total, the precatuions taken should avoid any danger from CO inhalation.

If the air exhaust system became partially clogged or in any way less than 100% effective or if excessive airborne contamination resulted from sectioning operations, continuous air monitors (CAMs) located throughout the sectioning, packaging, and general analytical lab areas would alarm. The CAM in the sectioning area is typically set to alarm at 35 MPC-hours. Thus, if levels in the sectioning area were as high as 100 x MPC, then the alarm would go off in less than 20 minutes. The emergency procedure specifically instructs that if a CAM alarm goes off, the CAM should first be reset (to assure that this is not just a spurious alarm). Then if the alarm goes off again or if the monitor recorder shows the activity level to be going up at a rapid rate, all should exit the area in an orderly fashion according to operating procedure requirements (see Procedure PFDL-OP-D-0853).

A fire alarm or criticality alarm would be included in this procedure. Because of the precautions taken, no life-threatening situations should develop and consequences of over-exposure are considerably mitigated. Thus no unforeseen, severe consequences should result from respiratory equipment or other laboratory system malfunctions.

If an individual's respiratory equipment is not used, inspected, serviced, or worn properly, some contamination could result on the inside surface of the mask or on the face of the individual. Such contamination would be detected by routine nasal or facial smears. If the contamination were high enough, bioassay procedures such as urine and fecal analysis or whole body count would also be required to assess the magnitude of the exposure.

5.0 METHODS FOR EVALUATING A RESPIRATORY PROTECTION PROGRAM EFFECTIVENESS

Several methods are used to evaluate the effectiveness of the respiratory protection program. These include:

A. Constant air monitoring throughout the PFDL building

B. Investigation of all airborne contamination levels exceeding 50% of the MPC for transportable plutonium

C. Logging in the total time that personnel are in the sectioning area along with the maximum air concentration during that workday

D. Routine and systematic urine bioassay on all personnel working at PFDL

E. Periodic whole body counting for personnel working in the laboratory areas

F. Systematic nasal and facial smears for personnel working in highly contaminated areas (e.g., sectioning complex)

G. Special contingency procedures for handling an unusual occurrence involving a potential exposure to radioactive material

Each of these monitoring features will be discussed with regard to its effectiveness in determining adequacy of the respiratory protection program.

5.1 Air Monitoring

Air monitoring at PFDL consists of sampling the air by drawing it through a number of fixed filter heads located strategically throughout the lab. These air filter samples are counted daily on an automated Tennelec LB 5100 alpha-beta detector. Results are recorded in hard copy in units of atto-curies/cc* and in percent of MPC_a. These fixed-head air samples tell us what the operating levels are throughout the lab, indicate where and how much respiratory protection is needed, and provide information to help assess individual and/or group airborne exposure levels.

5.2 Air Investigation Reports

Based on the daily air monitoring results noted in the paragraph above, all fixed air sample reports which exceed 50% of MPC_a must be investigated; and the results of this investigation must be reported in an air investigation report according to Procedure CS-IH-0202. Included in this are the sectioning operations in which it would be expected that airborne levels would exceed 50% on all days where sectioning operations occur. The stringent requirements for air investigations thus (1) forces the Supervisor of Industrial Hygiene to be aware of all elevated radiation levels where respiratory protection would be required and (2) enables him to take steps to reduce the potential exposures through better control of contamination, use of respiratory protection devices, limitations of the workers' activities, or better control of the working environment.

*1×10^{-12} atto-curie = 1 μCi. MPC_a for occupational exposure is 2×10^{-12} μCi/cc.

5.3 Logging of Exposure Conditions in Sectioning

Another assessment technique for controlling exposure to those doing sectioning operations is the logging in of the total time while working in the various sectioning operations (cutting up glove boxes, packaging, monitoring operations). This bookkeeping of personnel involvement was set up as part of the requirements in Procedure CS-IH-0708. Such a detailed accounting will permit an assessment of the internal inhalation exposure for each individual during each day of operation.

5.4 Routine Urine Bioassay

Urine bioassay samples are collected on a quarterly basis for all personnel working in potentially contaminated areas. Action point levels have been set at approximately four times the minimum detectable level. If the action point level is exceeded, another urine sample will be collected promptly to determine whether this was a spurious count or an indication of some internal accumulation of plutonium.

5.5 Whole Body Counting

Once a year laboratory personnel who have had the potential during the year for some uptake of radioactive material are counted in a portable, mobile counter. For personnel working in sectioning operations, whole body counts will be performed on a quarterly basis at the University of Pittsburgh Low-

Level Radiation Monitoring Facility. Results of these whole body counts have been used along with urine bioassay to assess possible internal exposure to plutonium and effectiveness of respiratory protection.

5.6 Nasal and Facial Smears

Nasal and facial smears are used to immediately assess effectiveness of the respiratory protection. Positive indications of contamination on the face or in the nose imply that the respirator may not have been completely effective in removing airborne contamination, perhaps due to misuse or careless contamination of the respirator. Such indications may require follow-up in obtaining special fecal and urine samples and/or whole body counting. These are handled by special contingency procedures as outlined below.

5.7 Special Contingency Bioassays

In the case of an unusual occurrence where there is a high potential that a significant intake occurred, special bioassay procedures have been set up for evaluating the internal exposure. The methods for how and when to do such special bioassay are outlined in Procedures CS-IH-0501 and 0502, respectively. The results of these special bioassays can also be used to assess an individual's internal exposure; and hence, can be used under certain conditions to evaluate the effectiveness of the respiratory protection program as well as the effectiveness of the ALARA program (to keep exposures as low as reasonably achievable).

All of the above assessment techniques, in reality, are combined to provide a total monitoring of the effectiveness of a respiratory protection program. A measure of effectiveness is especially essential in operations, such as sectioning, where we rely heavily on respiratory protection. With the safety and assessment features outlined above, a careful control can be maintained to assure the effectiveness of the respiratory protection and other safety measures to maintain internal exposures ALARA.

APPENDIX F

RADIOLOGICAL SURVEY MEASURING EQUIPMENT

DESCRIPTION OF MEASUREMENT EQUIPMENT

Three types of portable survey instruments were used (Table F-1) to perform the health physics surveys of the building's surfaces. These included the Eberline PAC-4G for monitoring fixed and removable alpha contamination, the Eberline E-120 with HP-190 probe attached for monitoring beta plus gamma contamination, and the Ludlum Model 19 Micro-R meter for monitoring gamma emissions.

The PAC-4G detector is a gas proportional probe with 50 cm^2 of active area and a thin (0.85 mg/cm^2) mylar window. The readout for this instrument is in the form of a continuous linear meter, reading from 0 to 500,000 counts per minute (cpm) with no range switching. This range is covered by four decades (0-500; 500-5,000; 0-50,000; and 50,000 to 500,000 cpm) through automatic switching for progressively increasing count rate.

The Eberline E-120 with HP-190 probe attached is a portable thin end window Geiger counter connected to a multiscale manually switchable readout taut band meter. The HP-190 probe is a Geiger-Mueller cylindrical detector with a thin (1.4-2.0 mg/cm^2) end window of mica. To gain maximum sensitivity, the instrument was calibrated and used in surveys without the plastic screen cap in place (efficiency is approximately doubled with the cap removed). The cylindrical detector has an effective diameter of 2.0 cm. The manufacturer quotes the typical 2π emission rate efficiency as 30 percent for Tc-99 (0.29 Mev maximum) betas and 10 percent for C-14 (0.15 Mev maximum) betas. The meter readout on this detector provides three linear ranges (0-600; 0-6,000; and 0-60,000 cpm). The thin end window allows detection for the very low beta energies typical of plutonium and will also respond to alphas. The HP-190 will respond to gammas although with much less efficiency (typically, 1.0 percent for Cs-137 [0.662 Mev] gammas) compared to 10-20 percent for detection of betas or alphas.

TABLE F-1

HEALTH PHYSICS SURVEY INSTRUMENT CHARACTERISTICS AND SURVEY LIMITS FOR FINAL SURVEYS OF BUILDING 8

Instrument Model	Type of Radiation Monitored	Minimum Detectable Level*	Maximum Allowable	Average Allowable
PAC-4G	Total Alpha (Fixed + Removable)	25 CPM Above Background $\left(\frac{100 \text{ dpm}}{100 \text{ cm}^2}\right)$	$300 \frac{\text{dpm}}{100 \text{ cm}^2}$	$100 \frac{\text{dpm}}{100 \text{ cm}^2}$
HP-190 Detector with Rascal PRS-1 Readout	Total Beta (Fixed + Removable)	30 CPM Above Background $\left(\frac{\sim 2,500 \text{ dpm}}{100 \text{ cm}^2}\right)$	$15,000 \frac{\text{dpm}}{100 \text{ cm}^2}$	$5,000 \frac{\text{dpm}}{100 \text{ cm}^2}$
Ludlum Model 19 Micro-R Meter	Gamma	10 μr/hr Above Background	500 μr/hr** @ ≤1 cm	100 μr/hr** @ ≤1 cm
PG-2 Detector on Rascal PRS-1 Readout	Gamma	∿20% Above Background		
LASS-1	Removable Alpha	4.6 CPM $\left(\frac{3.3 \text{ dpm}}{100 \text{ cm}^2}\right)$	$20 \frac{\text{dpm}}{100 \text{ cm}^2}$***	—
SAC-4	Removable Alpha	4.6 CPM $\left(\frac{3.3 \text{ dpm}}{100 \text{ cm}^2}\right)$	$20 \frac{\text{dpm}}{100 \text{ cm}^2}$***	--
Hewlett-Packard	Removable Alpha	4.6 CPM $\left(\frac{2.7 \text{ dpm}}{100 \text{ cm}^2}\right)$	$20 \frac{\text{dpm}}{100 \text{ cm}^2}$***	—
HP-190 Detector with E-120 Readout	Total Beta (Fixed + Removable)	25 CPM Above Background $\left(\frac{\sim 4,000 \text{ dpm}}{100 \text{ cm}^2}\right)$	$15,000 \frac{\text{dpm}}{100 \text{ cm}^2}$	$5,000 \frac{\text{dpm}}{100 \text{ cm}^2}$

*Based on 95% confidence level. MDL for LASS-1, SAC-4, and Hewlett-Packard assumes a 400 cm^2 surface area for statistical sampling as compared to standard 100 cm^2 area.

**Includes factor of 2 for calibration uncertainty.

***For grid survey, a limit of 10 dpm/100 cm^2 was used due to statistical uncertainty.

The Ludlum Model 19 Micro-R meter typically monitors gamma rays by use of an internally mounted 1-inch diameter, 1-inch thick NaI(Tℓ) scintillation detector unit. The meter reads directly on any one of three manually switchable scales which cover the ranges from 0-25, 0-50, 0-250, 0-500, and 0-5000 μr/hr.

Smear samples were taken to measure removable contamination levels. These samples were counted with bench-top counting systems sensitive to alpha radiation. Three different counting systems were utilized for these measurements. These included the Eberline LASS-1, the Eberline SAC-4, and a Hewlett-Packard automatic counter.

The SAC-4 is a scintillation alpha counter containing a 2-inch diameter ZnS(Ag) phosphor mounted on a 2-inch diameter photomultiplier tube. This detector is typically used for counting smear samples which are taken on 4.25 cm diameter filter paper. The preset timer permits taking 1, 2, 5, and up to 60-minute counts.

The LASS-1 (Laboratory Alpha Scantillation System) is a unit technically equivalent to the SAC-4 as described above. There are no significant differences in operating characteristics between the LASS-1 and the SAC-4 although they are significantly different in physical size and shape.

The Hewlett-Packard Model 5561A is an automatic sample changer alpha counter. This counter was used to process large quantities of smear samples in an expeditious manner (e.g., for the processing of all smears in a large room). The detector is a proportional counter and is connected to a scaler which in turn is linked with a mechanical printer. This counter's efficiency is typically similar to the LASS-1 and the SAC-4 detectors.

The instruments used for measurements made at relatively inaccessible locations (e.g., holes, ditches) included the Eberline PRS-1 rascal with a PG-2 detector and the HP-190 detector connected to an Eberline PRS-1 rascal.

The Eberline PRS-1 rascal with PG-2 detector is a portable thin crystal NaI(Tℓ) detector especially designed for monitoring low gamma energies typical of plutonium. Its large diameter and relatively high efficiency makes it very useful for monitoring drainpipes or soil.

The Eberline PRS-1 rascal with the HP-190 probe attached is a thin end window Geiger counter detector connected to a multiscaler digital readout portable counterscaler.

Table F-1 presents a summary of the instruments used along with the type of radiation measured, the minimum detectable level, and the applicable limits. As shown in Table F-1, all measurement techniques are sufficiently sensitive to establish that the applicable limits are being met for release of the facility for unrestricted use.

CALIBRATION AND LIMITATIONS

Laboratory bench-top calibrations were made on all alpha and beta sensitive instruments using NBS traceable sources.

The PAC-4G detector was calibrated by using a set of NBS traceable Pu-239 sources approximately 2 inches (5.08 cm) in diameter and the instrument gain controls were adjusted such that the readout showed a net counts per minute of 50 percent of the total disintegrations per minute based on 4π source emission. Thus, for the PAC-4G, the instrument correction factor was 4.0 dpm/100 cm^2 per cpm.

The HP-190 detector with E-120 readout was calibrated without the plastic cover over the detector (plastic grid removed) to increase sensitivity. Using the smallest Pu-239 source (650 dpm - 4), the measured efficiency was 9.2 percent and the instrument correction factor was 162 dpm/100 cm^2 per cpm.

The Ludlum Model 19 Micro-R meter was calibrated directly for gamma rays by use of an NBS secondary standard Cs-137 source so that the output was adjusted so that it corresponds directly to the value indicated on the readout (in units of mr/hr).

Calibration of the SAC-4 and LASS-1 alpha counters was accomplished by using a NBS traceable source of Pu-239 one inch in diameter. Efficiencies of SAC-4 and LASS-1 detectors typically ranged from 30 to 35 percent. Hence, a correction factor dpm/cpm of 3.0 has been used for these instruments.

The Hewlett-Packard automatic sample changer alpha counter was calibrated with the same one-inch diameter Pu-239 source used to calibrate the SAC-4 and LASS-1 detector systems. The efficiency in this case was found to be 35 percent. Hence, a correction factor (dpm/cpm) of 3.0 was again used.

The HP-190 probe on the PRS-1 rascal scaler-readout was calibrated with a 1100 dpm (4π) Pu-239 source with the HP-190 plastic grid cap cover removed. For this case, the efficiency (cpm/dpm) was determined to be 22 percent.

The PG-2 detector with metal grid cap removed was calibrated with a 6200 dpm (4π) Pu-239 source. This calibration resulted in a measured efficiency of 4 percent (cpm/dpm) and a correction factor of 125 (dpm 100 cm^2 per cpm above background).

Minimum detectable levels for all detectors are shown in Table F-1. It can be seen that in all cases, the limits of detection are equal to or less than allowable limits, but in some cases (e.g., total alpha), the minimum detectable is close to the allowable limits and, hence, more sensitivity would have been desirable.

Also, the PG-2 detector, which detects the low energy gamma rays from plutonium nuclides and Am-241, is very sensitive to extraneous gamma ray sources. During the final survey, the PG-2 detector had a high background (typically greater than 1200 cpm) due to nearby fuel waste containers. Hence, when this detector was used to monitor liquid waste piping, cracks in the floor, and trenches in the floor, high background sources were moved as far away as possible and 1/4-inch thick lead sheet was placed around the barrel of the detector unit to reduce the background as much as possible.

FACILITY RELEASE SURVEY PFDL Form #098, Rev. 0
SMEAR IDENTIFICATION AND SURVEY DATA

Building: #8 Area: MAA RESURVEY DATA PERIMETER AREAS

Suspected Radionuclides: PU

Detection System

Identification: RASCAL SN. 375

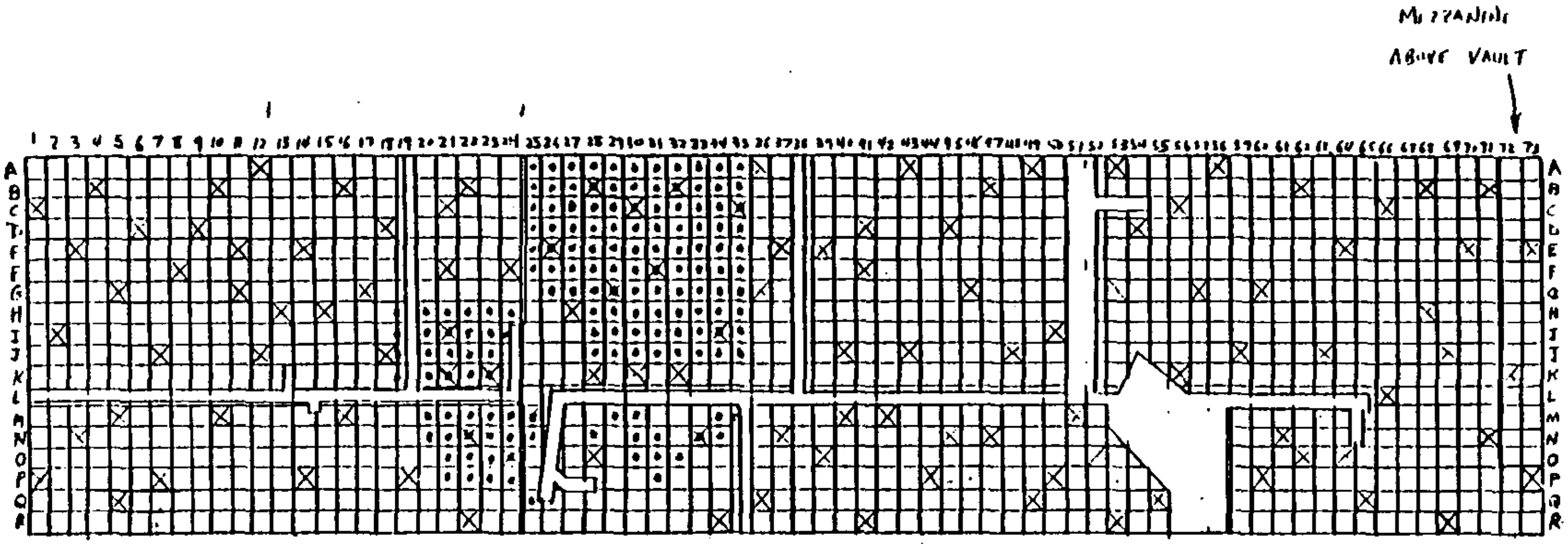
Counter Efficiency: 18% Counter Active Surface Area: 60 cm^2

Correction Factor (CPM to DPM/100 cm^2): 9.3 Background: 1.0

Survey Counting Time: 1 MIN

Survey Conducted By: GTP Date: 1-5-84

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
LL		<11	<11	<100			0
KK		<11	<11	<100			0
JJ		<11	<11	<100			0
DD		<11	<11	<100			0
EE		<11	<11	<100			0
FF		14	13	120.9			0
GG		<11	<11	<100			0
HH		<11	<11	<100			3
II		<11	<11	<100			0
CC		<11	<11	<100			0
BB		<11	<11	<100			3
AA		<11	<11	<100			0
Z		<11	<11	<100			3
~~A1~~		~~<11~~	~~<11~~	~~<100~~			
ZZ		<11	<11	<100			6
VV	RE CHECK	<11	<11	<100			
YY	RE CHECK	<11	<11	<100			

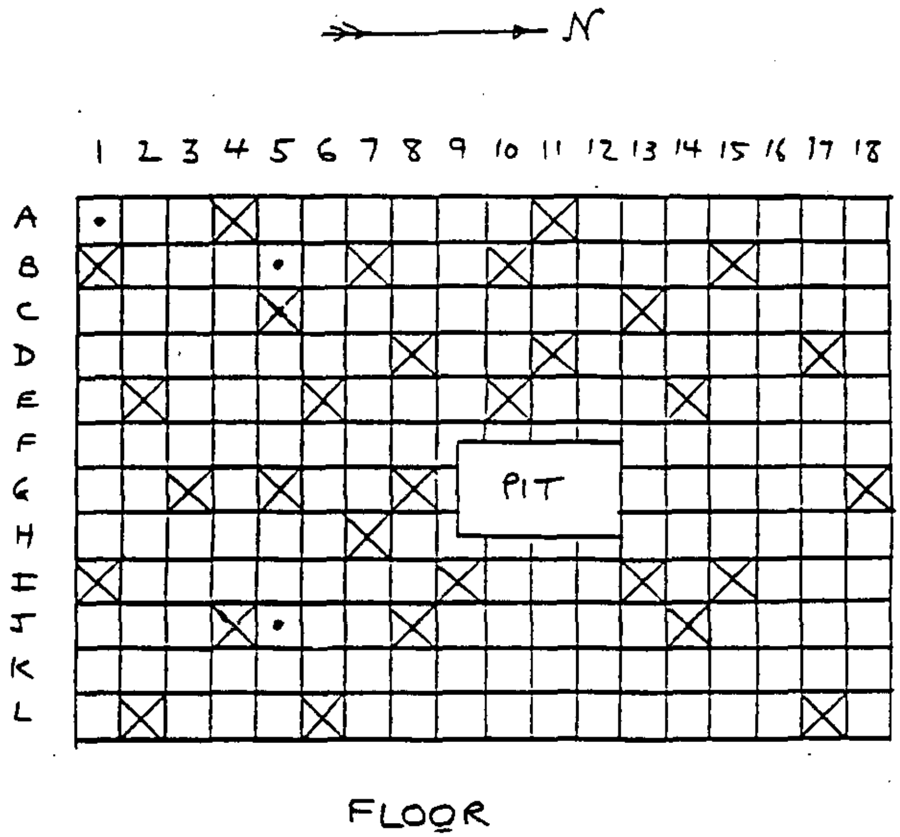


Notes: 1. "X" grids show original survey locations.

2. Dotted grids show areas which were found to be above NRC Guidelines during initial ORAU/NRC confirmatory surveys.

3. Grids = 1 m^2.

Figure G-1. PFDL Laboratory Floor Survey Grid Locations

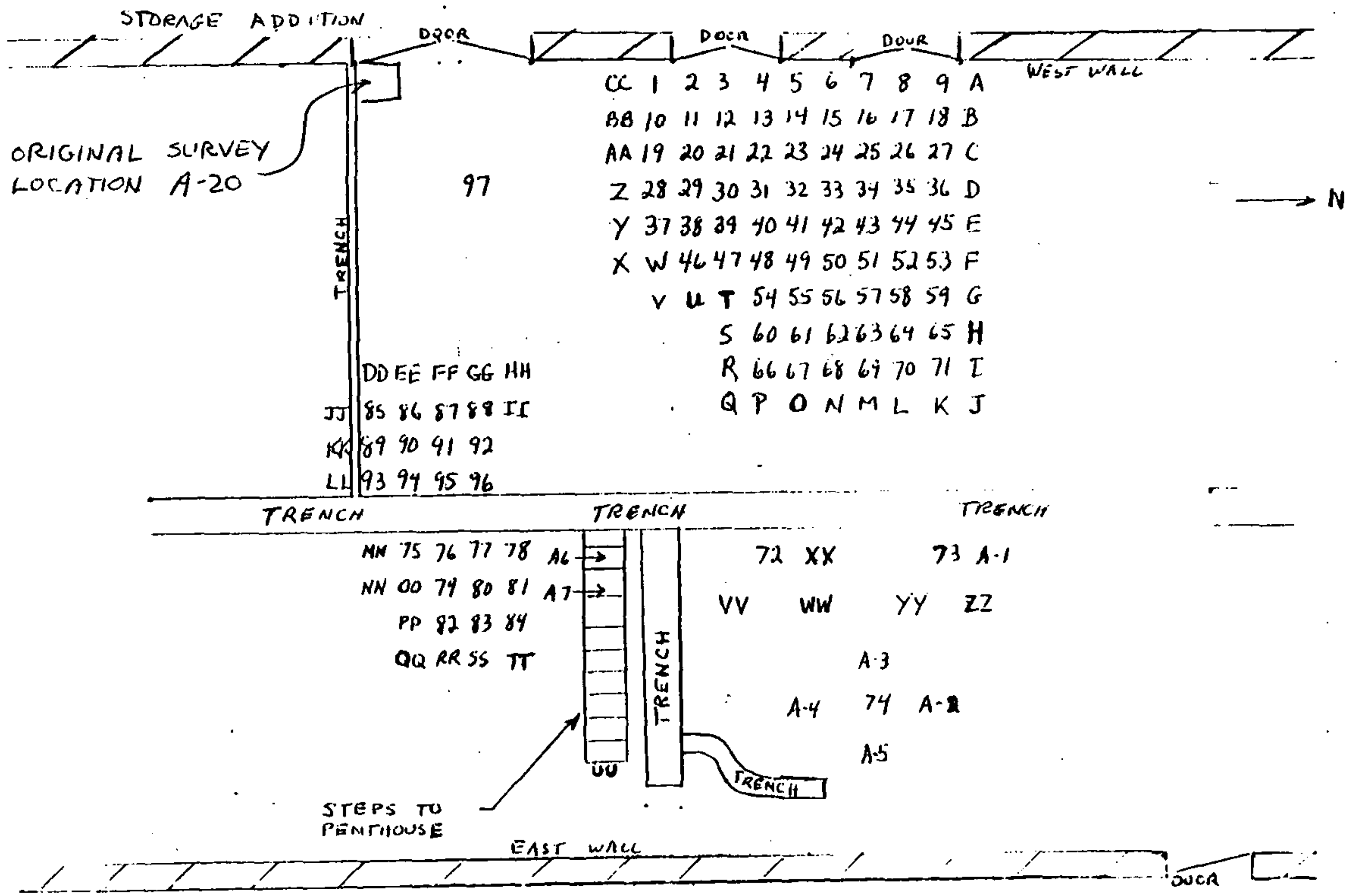


Note: 1. "X" grids show original survey locations

2. Dotted grids show areas which were found to be above NRC guidelines during initial ORAU/NRC confirmatory surveys.

3. Grids = 1 m^2

Figure G-2. PFDL Shipping and Receiving Survey Grid Locations



NOTE: Grids = 1 m^2.

Figrue G-3. PFDL Laboratory Survey Grid Locations for Final Survey After Scarifying the Floor

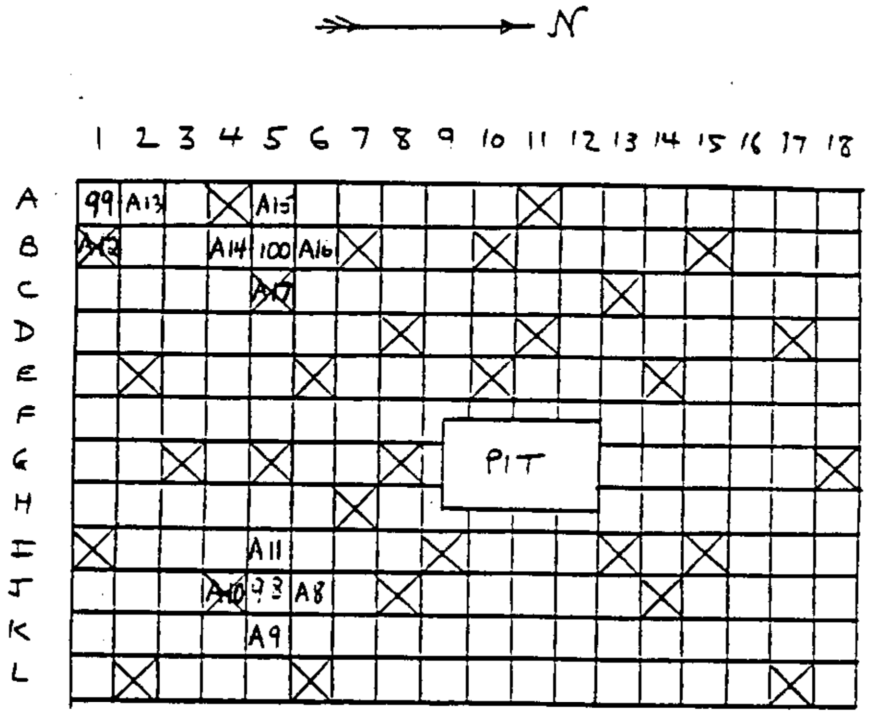


Figure G-4. PFDL Shipping and Receiving Survey Grid Locations for Final Survey After Scarifying the Floor

FACILITY RELEASE SURVEY　　PFDL Form #098, Rev. 0
SMEAR IDENTIFICATION AND SURVEY DATA

Building: 8　　Area: M.A.A, Recovery Dock, Floor Perimeter Areas

Suspected Radionuclides: Pu

Detection System

Identification: Rascal #720

Counter Efficiency: 18%　　Counter Active Surface Area: 60 cm^2

Correction Factor (CPM to DPM/100 cm^2): 9.5　　Background: 10

Survey Counting Time: 1 min

Survey Conducted By: RW Driggs　　Date: 1-5-84

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
A		< 11	< 11	< 100			3
B		< 11	< 11	< 100			3
C		< 11	< 11	< 100			0
D		< 11	< 11	< 100			3
E		< 11	< 11	< 100			3
F		< 11	< 11	< 100			0
G		< 11	< 11	< 100			0
H		< 11	< 11	< 100			0
I		< 11	< 11	< 100			0
J		< 11	< 11	< 100			0
K		< 11	< 11	< 100			6
L		< 11	< 11	< 100			0
M		< 11	< 11	< 100			3
N		< 11	< 11	< 100			0
O		< 11	< 11	< 100			3
P		< 11	< 11	< 100			0
Q		< 11	< 11	< 100			6
R		< 11	< 11	< 100			0
S		< 11	< 11	< 100			0
T		< 11	< 11	< 100			9

FACILITY RELEASE SURVEY PFDL Form #098, Rev. 0
SMEAR IDENTIFICATION AND SURVEY DATA

Building: E Area: MAC, Recovery Data Floor Perimeter Rooms

Suspected Radionuclides: ?

Detection System

Identification: Pascal #720

Counter Efficiency: 18% Counter Active Surface Area: 60 cm^2

Correction Factor (CPM to DPM/100 cm^2): 9.3 Background: 1.0

Survey Counting Time: 1 Min

Survey Conducted By: R.W. Diggs Date: 1-5-84

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
O		< 11	< 11	< 100			0
V		< 11	< 11	< 100			0
W		< 11	< 11	< 100			0
X		< 11	< 11	< 100			0
Y		< 11	< 11	< 100			0

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: #8 Area: MAA Re Survey Data PERIMETER AREAS

Suspected Radionuclides: PU

Detection System

Identification: RASCAL SN 375

Counter Efficiency: 18% Counter Active Surface Area: 60 cm^2

Correction Factor (CPM to DPM/100 cm^2): 9.3 Background: 1.0

Survey Counting Time: 1 MIN.

Survey Conducted By: GTP Date: 1-5-84

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
A2		<11	<11	<100			0
A3		<11	<11	<100			0
A4		<11	<11	<100			9
A5		18	17	158.1			9
A6		<11	<11	<100			0
A7		<11	<11	<100			0
A1		<11	<11	<100			3
VV	SEE RECHECK	66	65	604.5			3
WW		<11	<11	<100			5
XX		<11	<11	<100			0
YY	SEE RECHECK	26	25	232.5			0
UU		<11	<11	<100			0
TT		<11	<11	<100			0
SS		<11	<11	<100			0
RR		<11	<11	<100			0
QQ		14	13	120.9			0
PP		<11	<11	<100			0
OO		16	15	139.5			0
NN		<11	<11	<100			12
MM		<11	<11	<100			0

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: #8 Area: MAA RESURVEY DATA PERIMETER AREAS

Suspected Radionuclides: PU

Detection System

Identification: RASCAL SN. 375

Counter Efficiency: 18% Counter Active Surface Area: 60 cm^2

Correction Factor (CPM to DPM/100 cm^2): 9.3 Background: 1.0

Survey Counting Time: 1MIN

Survey Conducted By: GTP Date: 1-5-84

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
LL		<11	<11	<100			0
KK		<11	<11	<100			0
JJ		<11	<11	<100			0
DD		<11	<11	<100			0
EE		<11	<11	<100			0
FF		14	13	120.9			0
GG		<11	<11	<100			0
HH		<11	<11	<100			3
II		<11	<11	<100			0
CC		<11	<11	<100			0
BB		<11	<11	<100			3
AA		<11	<11	<100			0
Z		<11	<11	<100			3
~~A+~~		~~<11~~	~~<11~~	~~<100~~			
ZZ		<11	<11	<100			6
VV	RE CHECK	<11	<11	<100			
YY	RE CHECK	<11	<11	<100			

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: #8

Area: MAA RESURVEY DATA PERIMETER AREAS STORAGE ADDITION

Suspected Radionuclides: PU

Detection System

Identification: RASCAL . SN 375

Counter Efficiency: 18%

Counter Active Surface Area: 60 cm^2

Correction Factor (CPM to DPM/100 cm^2): 9.3

Background: 1.0

Survey Counting Time: 1 MIN.

Survey Conducted By: [signature]

Date: 1-5-84

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
A 8		<11	<11	<100			6
A 9		<11	<11	<100			C
A 10		<11	<11	<100			C
A 11		<11	<11	<100			3
A-12		<11	<11	<100			C
A 13		<11	<11	<100			C
A14		<11	<11	<100			3
A15		<11	<11	<100			C
A16		<11	<11	<100			6
A17		<11	<11	<100			C

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: #8 Area: MAA RE SURVEY DATA

Suspected Radionuclides: PU

Detection System

Identification: RASCAL SN 720 SN 375

Counter Efficiency: 18% Counter Active Surface Area: 60 cm^2

Correction Factor (CPM to DPM/100 cm^2): 9.3 Background: 1.0

Survey Counting Time: 1 MIN.

Survey Conducted By: GTP / RD / JR Date: 12/23/83

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
1		<11	<11	<100			
2		<11	<11	<100			
3		<11	<11	<100			
4		<11	<11	<100			
5		<11	<11	<100			
6		<11	<11	<100			
7		<11	<11	<100			
8		<11	<11	<100			
9		<11	<11	<100			
10		<11	<10	<100			
11		<11	<11	<100			
12		<11	<11	<100			
13		<11	<11	<100			
14		<11	<11	<100			
15		<11	<11	<100			
16		<11	<11	<100			
17		<11	<11	<100			
18		<11	<11	<100			
19		<11	<11	<100			
20		<11	<11	<100			

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: #8 Area: MAA RE SURVEY DATA

Suspected Radionuclides: Pu

Detection System

Identification: RASCAL SN 720 SN 375

Counter Efficiency: 18% Counter Active Surface Area: 60 cm^2

Correction Factor (CPM to DPM/100 cm^2): 9.3 Background: 1.0

Survey Counting Time: 1 MIN.

Survey Conducted By: GTP / RD / J.R. Date: 12/23/83

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
21		<11	<11	<100			
22		<11	<11	<100			
23		<11	<11	<100			
24		<11	<11	<100			
25		<11	<11	<100			
26		<11	<11	<100			
27		<11	<11	<100			
28		<11	<11	<100			
29		<11	<11	<100			
30		<11	<11	<100			
31		<11	<11	<100			
32		<11	<11	<100			
33		<11	<11	<100			
34		<11	<11	<100			
35		<11	<11	<100			
36		<11	<11	<100			
37		<11	<11	<100			
38		<11	<11	<100			
39		<11	<11	<100			
40		<11	<11	<100			

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: #8 Area: MAA Re Survey Data

Suspected Radionuclides: Pu

Detection System

Identification: Rascal SN 720 SN 375

Counter Efficiency: 18% Counter Active Surface Area: 60 cm^2

Correction Factor (CPM to DPM/100 cm^2): 9.3 Background: 1.0

Survey Counting Time: 1 MIN.

Survey Conducted By: GTP/RD/JR Date: 12/23/83

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
41		<11	<11	<100			
42		<11	<11	<100			
43		<11	<11	<100			
44		<11	<11	<100			
45		<11	<11	<100			
46		<11	<11	<100			
47		<11	<11	<100			
48		<11	<11	<100			
49		<11	<11	<100			
50		<11	<11	<100			
51		<11	<11	<100			
52		<11	<11	<100			
53		<11	<11	<100			
54		<11	<11	<100			
55		<11	<11	<100			
56		<11	<11	<100			
57		<11	<11	<100			
58		<11	<11	<100			
59		<11	<11	<100			
60		<11	<11	<100			

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: #8 Area: MAA RE SURVEY DATA

Suspected Radionuclides: PU

Detection System

Identification: RASCAL SN 720 SN 375

Counter Efficiency: 18% Counter Active Surface Area: 60 cm^2

Correction Factor (CPM to DPM/100 cm^2): 9.3 Background: 1.0

Survey Counting Time: 1 MIN

Survey Conducted By: GHP / RD / JR Date: 12/23/83

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
61		<11	<11	<100			
62		<11	<11	<100			
63		<11	<11	<100			
64		<11	<11	<100			
65		<11	<11	<100			
66		<11	<11	<100			
67		<11	<11	<100			
68		<11	<11	<100			
69		<11	<11	<100			
70		<11	<11	<100			
71		<11	<11	<100			
72		<11	<11	<100			
73		<11	<11	<100			
74		<11	<11	<100			
75		<11	<11	<100			
76		<11	<11	<100			
77		<11	<11	<100			
78		<11	<11	<100			
79		<11	<11	<100			
80		<11	<11	<100			

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: #8 Area: MAA Re Survey Data

Suspected Radionuclides: Pu

Detection System

Identification: RASCAL SN 720 SN 375

Counter Efficiency: 18% Counter Active Surface Area: 60 cm^2

Correction Factor (CPM to $DPM/100\ cm^2$): 9.3 Background: 1.0

Survey Counting Time: 1 MIN

Survey Conducted By: GTP/RD/JR Date: 12/23/83

Grid I.D.	Gross Counts	Gross CPM	Net CPM	$dpm/100\ cm^2$	Smear No.	Smear Coordinates	Smear Results $dpm/100\ cm^2$
81		<11	<11	<100			
82		<11	<11	<100			
83		<11	<11	<100			
84		<11	<11	<100			
85		<11	<11	<100			
86		<11	<11	<100			
87		<11	<11	<100			
88		<11	<11	<100			
89		<11	<11	<100			
90		<11	<11	<100			
91		<11	<11	<100			
92		<11	<11	<100			
93		<11	<11	<100			
94		<11	<11	<100			
95		<11	<11	<100			
96		<11	<11	<100			
97		<11	<11	<100			
98		<11	<11	<100			
99		<11	<11	<100			
100		<11	<11	<100			

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: 8 Area: MAA Resurvey Data, Floor

Suspected Radionuclides: Pu

Detection System

Identification: SAC-4s

Counter Efficiency: 43%, 42%, 44%, 40% Counter Active Surface Area: ______ cm^2

Correction Factor (CPM to DPM/100 cm^2): 2 2 2 3 Background: .1 .1 .1 .3

Survey Counting Time: 1 min

Survey Conducted By: RD/GP/JP Date: 1-4-84

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
1					1		0
2					2		9
3					3		0
4					4		0
5					5		0
6					6		3
7					7		9
8					8		0
9					9		0
10					10		3
11					11		0
12					12		0
13					13		0
14					14		0
15					15		3
16					16		0
17					17		0
18					18		3
19					19		0
20					20		0

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: 8 Area: MAA Resurvey Data, Floor

Suspected Radionuclides: Pu

Detection System

Identification: SAC-4

Counter Efficiency: 43%, 42%, 41%, 40% Counter Active Surface Area: ____ cm^2

Correction Factor (CPM to DPM/100 cm^2): 2 2 2 3 Background: 1 1 1 3

Survey Counting Time: 1 min

Survey Conducted By: RD/GP/JR Date: 1-4-84

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
21					21		3
22					22		6
23					23		3
24					24		0

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: 8 Area: M.4A Re survey [illegible]

Suspected Radionuclides: Pu

Detection System

Identification: SAC-4

Counter Efficiency: 43% 42% 41% 46% Counter Active Surface Area: ______ cm^2

Correction Factor (CPM to DPM/100 cm^2): 2, 2, 2, 3 Background: 1, 1, 1, 3

Survey Counting Time: 1 min

Survey Conducted By: PD/GP/JR Date: 1-4-84

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
25					25		0
26					26		0
27					27		6
28					28		0
29					29		0
30					30		0
31					31		3
32					32		0
33					33		0
34					34		3
35					35		3
36					36		0
37					37		0
38					38		0
39					39		6
40					40		0
41					41		0
42					42		0
43					43		6
44					44		0

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: F

Area: MAA Recovery [illegible]

Suspected Radionuclides: Pu

Detection System

Identification: SAC-4's

Counter Efficiency: 43%, 42%, 44%, 40%

Counter Active Surface Area: ____ cm^2

Correction Factor (CPM to $DPM/100\ cm^2$): 2, 2, 2, 3

Background: 1, 0, 1, 3

Survey Counting Time: 1 min

Survey Conducted By: [illegible]

Date: 1-4-84

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
45					45		0
46					46		0
47					47		3
48					48		0
49					49		0
50					50		0
51					51		3
52					52		0
53					53		0
54					54		3
55					55		3
56					56		0
57					57		0
58					58		0
59					59		3
60					60		0
61					61		0
62					62		0
63					63		15
64					64		0

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: E
Area: MAA Recovery Data Floor

Suspected Radionuclides: Pu

Detection System

Identification: SAC-4

Counter Efficiency: 43%, 42%, 44%, 40%
Counter Active Surface Area: ______ cm^2

Correction Factor (CPM to $DPM/100\ cm^2$): 2, 2, 2, 3
Background: 1, 1, 1, 3

Survey Counting Time: 1 min

Survey Conducted By: TD/GF/JR
Date: 1-4-84

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm²	Smear No.	Smear Coordinates	Smear Results dpm/100 cm²
65					65		0
66					66		0
67					67		0
68					68		0
69					69		0
70					70		3
71					71		3
72					72		0
73					73		0
74					74		9
75					75		0
76					76		0
77					77		9
78					78		0
79					79		3
80					80		0
81					81		3
82					82		0
83					83		0
84					84		0

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: E

Area: MAA Recovery Data Fluc

Suspected Radionuclides: Pu

Detection System

Identification: SAC-4s

Counter Efficiency: 43% 42% 44% 40%

Counter Active Surface Area: ______ cm^2

Correction Factor (CPM to DPM/100 cm^2): 2 2 2 3

Background: 1 1 1 3

Survey Counting Time: 1 min

Survey Conducted By: MM/GP/JR

Date: 1-4-71

Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
85					85		3
86					86		0
87					87		0
88					88		0
89					89		6
90					90		0
91					91		0
92					92		3
93					93		0
94					94		0
95					95		0
96					96		0
97					97		6
98					98		0
99					99		0
100					100		0

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: 8 Area: MAA RESURVEY DATA GENERAL FLOOR AREA

Suspected Radionuclides: PU

Detection System

Identification: SAC 4s #387, 420, 432, 181

Counter Efficiency: 43%, 42%, 44%, 40% Counter Active Surface Area: ______ cm^2

Correction Factor (CPM to DPM/100 cm^2): 2, 2, 2, 3 Background: 1, 1, 1, 3

Survey Counting Time: 1 MIN.

Survey Conducted By: GTP Date: 1-4-84

ORIGINAL Grid I.D.*	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
P-44					1	SURFACE	0
N-47					2	AREA =	2
P-50					3	400 cm^2	0
Q-55					4		0
P-60					5		0
O-64					6		0
N-71					7		0
H-68					8		0
E-64					9		0
B-62					10		0
A-58					11		0
C-56					12		0
A-53					13		0
G-57					14		0
G-53					15		0
G-46					16		0
D-41					17		0
J-40					18		0
N-33					19		0
F-21					20		0

* See Figure E-1

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: 8 Area: MAA RESURVEY DATA GENERAL FLOOR AREA

Suspected Radionuclides: PU

Detection System

Identification: SAC 4S #387, 420, 432, 181

Counter Efficiency: 43%, 42%, 44%, 40% Counter Active Surface Area: ______ cm^2

Correction Factor (CPM to DPM/100 cm^2): 2, 2, 2, 3 Background: 1, 1, 1, 3

Survey Counting Time: 1 MIN.

Survey Conducted By: GTP Date: 1-4-84

ORIGINAL Grid I.D.*	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
B-22					21	SURFACE	0
G-17					22	AREA	0
J-18					23	400 cm^2	0
H-15					24		0
E-14					25		0
H-13					26		0
J-12					27		0
F-8					28		0
D-6					29		0
E-3					30		0
N-3					31		0
M-5					32		0
P-7					33		0
P-14					34		0
M-16					35		0
P-19					36		0

* See Figure E-1

FACILITY RELEASE SURVEY
SMEAR IDENTIFICATION AND SURVEY DATA

PFDL Form #098, Rev. 0

Building: 8

Area: MAA Resurvey Data STORAGE ADDITION GENERAL ~~FLOOR AREA~~

Suspected Radionuclides: PU

Detection System

Identification: SACHS #387, 420, 432, 181

Counter Efficiency: 43%, 42%, 44%, 40% Counter Active Surface Area: ______ cm^2

Correction Factor (CPM to DPM/100 cm^2): 2, 2, 2, 3 Background: 1, 1, 1, 3

Survey Counting Time: 1 MIN.

Survey Conducted By: GTP Date: 1-4-84

ORIGINAL Grid I.D.	Gross Counts	Gross CPM	Net CPM	dpm/100 cm^2	Smear No.	Smear Coordinates	Smear Results dpm/100 cm^2
J-8					1	SURFACE	0
J-4					2	AREA =	0
G-3					3	400 cm^2	0
E-2					4		0
C-5					5		0
B-7					6		0
B-10					7		0
D-11					8		0
E-14					9		0
D-17					10		0
G-18					11		0
I-15					12		0
L-17					13		0
I-13					14		0
*	See Figure	E-1					

APPENDIX H

TOOLING, EQUIPMENT, AND SUPPLIES

NIBBLERS

A.E.G. Model KN-5, manufactured by A.E.G. Power Tool Corporation, Norwich, CN, approximate cost $800. Used for sectioning 10 and 12 gauge stainless steel glove boxes. This unit was found to be the best for cutting stainless steel.

"Super Nibbler," manufactured by Fenway Tool Company, approximate cost $1,295. This unit was too heavy to operate without the use of a balance. Also, the body design was too large to allow for use in confined areas of a glove box, i.e., corners and around penetrations.

Gobbler, manufactured by Modern Machine Company, Philadelphia, PA, approximate cost $700. This unit was used to cut glove box sections. It was found to have an extremely high noise level, and did not operate as effectively as the A.E.G. unit.

RECIPROCATING SAWS

Model 8098, manufactured by Ingersol Rand Corporation, approximately cost $150. This saw was used at the start of the operations. The first few units with variable speed had a high rate of trigger speed control failure. We tried other manufacturers' saws, but returned to the variable speed Ingersol for reasons indicated below.

Model 3105-09, manufactured by Black & Decker Corporation, approximate cost $150. This saw was used for various applications, but was found to have too large of a body design to work in a glove box safely. The front guide for the blade was also too large for close work.

Model 831, manufactured by Rigid Tool Company, Elyria, OH, approximate cost $225. This saw was used during various operations in the laboratory. The manufacturer does not make a variable speed saw, only a two-speed unit. The two speeds did not provide optimum control; lower speeds were needed when starting and finishing cuts and when working around tight radii in order to prevent grabbing and kicking of the saw.

RECIPROCATING SAW BLADES

Model 4800-1182, manufactured by Milwaukee Electric Tool Corporation, Brookfield, WI, approximate cost $1.35/each. The blades used were very flexible bi-metal blades with 14 teeth per inch and 6 inches long. This flexibility was one of the reasons the blade was so successful. Over 10,000 blades were used in this decontamination and decommissioning effort.

Model SS4-5CH "Grit Edge," manufactured by Remington Arms Company, Bridgeport, CN, approximate cost $1.75/each. These blades were 4 inches or 6 inches in length and were made of tungsten carbide. They did not perform as well as the Milwaukee blades on stainless steel; however, on Inconel from the sintering furnace complex, they outperformed all of the saw tooth blades.

Blu-Mol M1446, manufactured by Miller Falls Company, Greenfield, MA, approximate cost $1.25/each. Poor for cutting stainless steel and Inconel.

Model 810 Lenox Hackmaster, manufactured by American Saw & Manufacturing Company, Longmeadow, MA, approximate cost $1.35/each. These blades performed almost as well as the Milwaukee 1182. They were 14 teeth per inch, 6 inches and 8 inches in length. One advantage of these blades was the extra length available (8 inches). The advantage of having an 8-inch blade was that some of the equipment in glove boxes was located too far from the window for cutting using the 6-inch blade.

GLOVES

Model 66NFW Nitty Gritty Gloves, manufactured by Best Manufacturing Company, Menlo, GA, approximate cost $33/dozen. These gloves were worn inside glove boxes whenever possible while using the reciprocating saws. They were also used in the sectioning tent to handle sharp sectioned pieces of glove box. The gloves are constructed of 5-piece liner, coated with natural rubber wrinkle finish to allow for ease of gripping, with a high degree of puncture resistance.

PIPE CUTTERS

Model 42-A Rigid Heavy Duty 4-Wheel Pipe Cutter, manufactured by Rigid Tool Corporation, Elyria, OH, approximate cost $100/each. These pipe cutters were used to cut contaminated stainless steel pipe in close locations. Operation required only slightly greater than 1/4 turn. The cutting wheels for stainless steel were ordered separately.

PORTABLE BAND SAW

Various types were used: Rigid, Rockwell, and Black & Decker. All units performed equally for cutting heavy wall pipe and other metal shapes with heavy cross sections. Approximate cost $400/each.

SMALL NIBBLER

Model 2000, manufactured by Fein Tool Company, Stuttgart, West Germany, approximate cost $500/each. Easy to handle with one hand. Worked well on 14 gauge stainless steel duct and aluminum.

COMPACTOR

Model 65G41901N, Sears Standard Compactor, approximate cost $350. Used to compact potentially contaminated room trash and contaminated coveralls, plastic, etc. collected from inside the sectioning tent.

AIR BAGS

Six-Ply Paper Dunnage Bags, manufactured by Shipping Systems, Inc., Crossett, AR, approximate cost $13/each. Used to secure shipping containers inside the Super Tiger (DOT 6400 overpack).

PAINT REMOVER

KS-3 Kleen Strip, manufactured by M. W. Barr, Memphis, TN. Used to remove paint from floors, walls, and ceilings within the laboratory. Comes in 1, 5, and 55-gallon containers and leaves no offensive odor when using.

SPRAY GUN

Model 62 Spray Gun, \$150/each, and Model 66SH Fluid Air Nozzel, \$25/each, manufactured by Binks Company, Chicago, IL. Used for applying PVA fixative to the inside surfaces of glove boxes.

FOAM PACKING

Etha Foam, 54" x 250' x 1/4" thick, manufactured by Dow Chemical Company, Midland, MI, approximate cost \$200/roll. Used to pad sharp-edged pieces to avoid punctures to the .012" PVC plastic sheet wrapping.

Z.R.C. GALVANIZING SPRAY

Z.R.C. Chemical Products, Quincy, MA, approximate cost \$5.50/can. Used to touch-up galvanized 55-gallon drums and N-55 overpack shipping containers.

SEALANT

No. 732 RTV Sealant, manufactured by Dow Corning Corporation, Midland, MI, approximate cost \$6/each. Used throughout the D&D operations as a caulking sealant.

CONCRETE CUTTING SAW

Model 3005 "Target," manufactured by Robert Evans Company, Kansas City, MO, approximate cost \$7,000. Saw blades cost about \$600/each. Saw was 35 HP with 18-inch diamond saw blade, and a 6-inch cut depth. Water coolant is required for the diamond blade. The saw was used to remove sections of concrete floor for access to underground pipes; a larger saw is recommended for faster operation.

FLOOR SCARIFIER

Models V-5 and 1-VF "Scabbler," manufactured by MacDonald Air Tool Corporation, Hackensach, NJ; approximate cost of the V-5 Model is $5,000, and of the 1-VF Model is $2,000. Used to scarify the top surface of concrete. The Model V-5 mounted on wheels has 5 heads, and the Model 1-VF is a single head hand-held unit. If the units are operated dry, it is desirable to have a vacuum system to control dust. Models are available in larger and smaller sizes.

JIB RIG CRANE

Used to lift heavy equipment in locations not directly accessible to a forklift truck or overhead crane. It attaches to the forks on lift trucks, and has a telescoping boom for increased versatility.

SCAFFOLDS

Aluminum scaffolds were used throughout the laboratory and within the sectioning tents. Scaffolds were 4' wide x 8' long and were adjustable to 12'; this 4' wide scaffolding was used to allow for stability while personnel were working.

PACKAGING SYSTEM

Instapak Polyurethane Foaming System, manufactured by Sealed Air Corporation, Sharonville, OH, approximate cost $1,500. Used to enclose and fill voids in equipment and containers for burial. Foam is supplied in either 50-pound containers or 55-gallon drums. Foam used was 2/ft3 rigid blocking and bracing foam.

LIFTING DEVICE

Genie Personnel Lift, manufactured by Genie Personnel Lift, Kirkland, WA. This is a one-person lift to help perform work overhead that could not be done from a ladder or with the use of a forklift truck. It is an electric-powered lift equipped with outriggers for stability. The operator is enclosed in a basket equipped with an up and down button to allow for a one-person operation.

At various times, small floor cranes, lift tables, and hydraulic scissor jacks were used to lift, hold, and position various pieces of equipment.

DISPOSABLE SUPPLIES

Rolls of yellow plastic tape 2" wide x 36 yards were used extensively during the D&D operations. Approximate cost, $5/roll.

PVC plastic sheet .012" x 54" wide was used to package equipment for burial. Bags were fabricated in-house to meet individual needs. Approximate cost, $150/roll.

Olive drab cloth tape 2" wide x 60 yards was used for sealing all seams on the sectioning tent. This tape was also used where low temperatures were encountered, as the yellow plastic tape became very brittle under these conditions. Approximate cost, $7/roll.

Cleaning cloths, Type 910, 24" x 24" yellow oil-based cloth manufactured by Chicopee Manufacturing Company, New Brunswick, NJ. Used to wipe down equipment as well as provide padding for corners of some equipment. Approximate cost, $150/case.

OAKITE CLEAR COAT

Oakite Clear Coat, 20-gallon container, manufactured by Oakite Products, Berkley Heights, NJ; approximate cost, $10.50/gallon. This PVA base liquid was used as a fixing agent for spraying onto the inside surfaces of glove boxes and various pieces of equipment.

DECONTAMINATION SOLUTION

NUTEC,F600EL, Low Foaming Solution, manufactured by Suntrac, Inc., Webster, TX; approximate cost $550/drum. Used generally as a decontamination agent. Performed effectively and is a neutral pH. Available in 55-gallon drums and smaller quantities.